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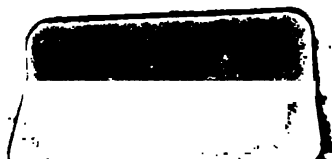
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AN ATLAS
OF
HUMAN ANATOMY.



AN ATLAS
OF
HUMAN ANATOMY

ILLUSTRATING

*MOST OF THE ORDINARY DISSECTIONS AND MANY NOT USUALLY
PRACTISED BY THE STUDENT.*

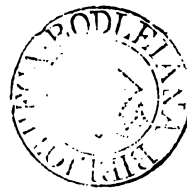
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*The Preface to this Work will be found with the Volume
of Plates.*

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ERRATA.

Page 9, line 18, *after* "transverse cervical" *add* "or, as it may be called, posterior scapular."

„ 10, last line but two, *for* "one" *read* "some."

„ 11, line 22, *for* "branch" *read* "trunk."

„ 17, „ 10, *for* "covered" *read* "crossed."

„ 20, „ 20, *for* "ascending cervical" *read* "princeps cervicis."

„ 24, „ 4, *before* "sixth" *insert* "internal branches of the."

„ 33, „ 15, *erase the words* "origin of."

„ 43, „ 17, *after* "external to" *insert* "or behind."

„ 44, „ 20, *erase* "or temporo-maxillary."

„ „ „ 22, *after* "posterior facial" *add* "or facial communicating."

„ „ „ 31, *for* "temporal" *read* "zygomatic."

„ 141, „ 4, *for* "Czemak" *read* "Czermak."

„ 150, „ 14, at end *erase* "well."

„ 167, „ 13, *for* "(p. 178)" *read* "(p. 198)."

„ 174, „ 20, *erase* "six."

„ „ „ 21, *erase* "and the bone of the seventh rib."

„ 177, between third and fourth paragraphs *insert* "ARTERIES."

„ 237, line 9, *after* "and one" *substitute* "of" *for* the comma."

„ 268, „ 28, *for* "is represented" *read* "are represented."

„ „ „ 29, *for* "it has" *read* "they have."

„ 274, after the fourth paragraph *insert*

"The two *bronchi* are seen passing outwards, from the bifurcation of the trachea, to their respective lungs. It will be noticed that the right bronchus, †, is larger and more transverse than the left, ††. Each occupies the posterior part of the root of the lung to which it belongs, but the right is somewhat higher than the left. A foreign body which has entered the trachea finds its way, as a rule, into the right bronchus, the septum between the two tubes being situated to the left of the middle line of the trachea."

Page 281, line 6, *for* "cutaneus" *read* "cutaneous."

„ 298, between first and second paragraphs *insert* "MUSCLES."

Page 302, *After second paragraph insert*

"The *Gracilis*, F, arises, by a very narrow origin, from the symphysis pubis and the upper two-thirds of the pubic arch. It forms above a thin flattened muscle, which becomes narrower and thicker below, and ends in a long rounded tendon, which, after passing at first vertically downwards, curves forwards, to be inserted, beneath the expansion derived from the sartorius, into the upper part of the inner surface of the tibia. The muscle is subcutaneous, except where it is covered by the expansion just alluded to. It rests upon the inner edges of the adductor muscles and the inner part of the knee joint. It acts as an adductor of the thigh and a flexor and rotator of the knee."

Page 322, line 14, *for* "the point to reach" *read* "point to reach the."

„ 360, „ 7, *for* "adductor and flexor brevis digitorum" *read*
"flexor brevis digitorum, to the abductor and."

„ 364, „ 16, *for* "arc" *read* "arch."

AN ATLAS

OF

HUMAN ANATOMY.

PLATE 1.

FIG. 1,

Is intended to show the sterno-mastoid muscle and the cervical fascia covering it and the adjacent parts. The dissection is made by reflecting the skin for an inch or more beyond the edge of the sterno-mastoid in all directions; the two borders of the muscle may be felt sufficiently easily, if not seen through the skin, to serve as guides. On removing the subcutaneous fat the platysma is exposed, and lying upon it are a few twigs of the superficial cervical nerve. The platysma is then removed, uncovering the deep cervical fascia; and the arrangement of this is demonstrated by cutting away that part of it which covers the upper and lower portions of the sterno-mastoid, and making the incisions which are seen near the middle line, and which expose the omo-hyoid, the parotid and submaxillary glands and an interval between two layers of the fascia just above the episternal notch.

The deep Cervical Fascia will appear in several dissections; a general description will be given in this place. It forms a complete sheath for the sterno-mastoid muscle, thin above the level of the platysma, but thicker below; which is attached above, like the muscle, to the superior curved line

of the occipital and mastoid process of the temporal bones, and below to the clavicle. Traced backwards, it forms a roof for the posterior triangle, at the posterior margin of which it splits to receive the trapezius, and is attached to the ligamentum nuchæ in the middle line. Traced forwards from the anterior border of the sterno-mastoid, it forms sheaths for the parotid, ¶, and submaxillary, †, glands, and is firmly attached to the angle and ramus of the jaw; a part is also continued over the masseter muscle, C, to be attached to the zygoma. This has been described as a separate fascia—"parotidio masseterica" (Hyrtl, "Topographische Anatomie," vol. i. § lxxvi. d). Below the submaxillary gland the fascia covers over the muscles in the submaxillary region, and is firmly attached to the hyoid bone. Below this again it covers the depressors of the hyoid bone, and then splits into two layers which are attached to the anterior and posterior borders of the upper part of the sternum; these include between them a small space (indicated by *) which contains a little fat. The deeper of them is continued along the posterior belly of the omo-hyoid, which it binds down to the clavicle and first rib. Another layer lies behind the sterno-hyoid and sterno-thyroid, forming in fact the posterior part of a sheath which encases them, and this is continued down on the front of the thyroid gland and trachea to the pericardium; in connexion with this is the sheath of the great vessels of the neck. A continuation of this also covers the scalene muscles, and supplies the tubular sheath which surrounds the subclavian and axillary vessels. The portion of fascia which separates the parotid and submaxillary glands is attached firmly to the angle of the jaw and the styloid process, and is called the stylo-maxillary ligament.

The surgical importance of the cervical fascia depends upon the power which it exercises, like all strong fasciæ, of modifying the course of an abscess or the growth of a tumour. Thus after tracheotomy, or cut throat, pus may be conducted by the

fascia behind the sterno-hyoid and sterno-thyroid muscles into the chest; and an early diagnosis is often difficult in cases of parotid bubo, or of those soft tumours to which this gland is liable.

MUSCLES.

Platysma Myoides, D, D.—With a broad origin below from the fascia over the front of the chest and arm, and also from the clavicle and acromion process, the fibres are directed upwards and inwards to the angle of the jaw. A few meet and cross just below the symphysis; most are attached to the lower border of the body of the jaw from the symphysis to the masseter; and others pass over the side of the face to blend with the muscles of the side of the mouth, and to be inserted into the zygoma.

This is one of the few subcutaneous muscles which remain to man. Its action is weak; it wrinkles the skin of the neck, or may depress the lower jaw. Hyrtl considers that its contraction will cause a dilatation of the external jugular veins, with a consequent suction of blood into them from their tributaries, and he suggests this as a reason why this vein, though cutaneous, should lie beneath and not above the muscle ("Top. Anat.," i. § xcvi. a). The fibres which pass to the corner of the mouth give it some power as a muscle of expression. Duchenne calls it "le muscle de la frayeur."

Sterno-mastoid, A.—As looked at from the surface this muscle arises by two heads more or less united together. One tendinous and strong, from the upper border and part of the anterior surface of the sternum; the other from the upper border and part of the anterior surface of the inner third of the clavicle, and is inserted by a broad tendon into the whole of the mastoid process, and the outer part of the superior curved line of the occipital bone. Closer examination, however, shows that in most cases the muscle is divided up into more fasciculi. Professor Krause, of Göttingen, describes it as consisting of four muscles—a sterno-mastoid and sterno-

occipital, which together constitute our sternal head ; a cleido-occipital, which is our clavicular head ; and, more deeply situated, the cleido-mastoid, arising behind the cleido-occipital, and having a separate attachment to the mastoid process. The accompanying woodcut, which was taken from the same



A Sternal head (sterno-mastoid and sterno-occipital). B Anterior part of insertion (sterno-mastoid). C Clavicular head (cleido-occipital). D Posterior part of insertion (cleido-occipital and sterno-occipital). E Cleido-mastoid, dividing into two parts, between which passes the spinal accessory nerve ¶.

H Trapezius. I Splenius. J Levator anguli scapulae. K Scalenus medius. L Scalenus anticus. M Masseter. N Omohyoid. O Sterno-thyroid. P Sterno-hyoid.

† Parotid gland.

subject as the plate, illustrates this arrangement. As in Krause's description, the spinal accessory perforates the cleido-mastoid portion, and in this case the posterior part of this head, G, had a separate insertion into the tip of the mastoid process in front of the splenius. It is after perforating the deep head that the nerve supplies its muscular branches.

The anterior edge of the muscle is in close contact with the angle of the jaw, except when the head is forcibly drawn to the opposite side.

The relations of the muscle are sufficiently explained by Figs. 1 and 2 to make a detailed description unnecessary.

Its action has been the subject of considerable difference of opinion. If one muscle contract while the head is erect, the face and chin are drawn to the opposite side, and the head is slightly flexed. If both muscles act while the head is erect, flexion is produced (hence the German name, *Kopfnicker*); while, if the neck be already extended, the amount of extension is increased. Hyrtl is probably right in thinking that it has an important function in maintaining the balance of the head, for it will be felt to contract in almost every movement of the neck. Its action, as an extraordinary muscle of inspiration, can only take place when the head is fixed.

The surgical interest of the muscle is great. Its anterior border is the guide to the line of the carotid vessels. Tonic contraction of one sterno-mastoid gives rise to wry-neck (*torticollis, caput obstipum*), for which tenotomy must sometimes be practised. The usual position for this operation is about an inch above the origin. The surgeon must bear in mind the position of the internal, external, and anterior jugular veins; the first is best avoided by pinching up the sternal head in the fingers. To the physician the muscle is interesting as an indication of the seat of a nervous lesion when it is paralysed, and as being the subject of clonic contractions, causing *spasmodic torticollis*; or, if both sides be affected, *nutatory spasm*.

ARTERIES.

The cutaneous arteries of this region are unimportant. The upper part is supplied by the *occipital*, *a*, and *posterior auricular*, *b*, the middle by the *carotid*, *c c*, and *superior thyroid*, *d*, and the lower by some of the *branches of the subclavian*, *e, e, f, g*, or sometimes by a twig from the artery itself.

VEINS.

External Jugular, α .—This represents nearly the typical form, but it is liable to great varieties. Beginning in the substance of the parotid gland by the union of the temporal with the internal maxillary trunks, and, joined by the posterior auricular, it passes downwards and backwards across the sternomastoid, receiving in its course one large posterior and several small anterior branches; it perforates the deep fascia at the lower part of the posterior border of the muscle, and, passing below or above the omo-hyoid, forms a plexus with the anterior jugular, supra-scapular, transverse cervical, and posterior scapular veins, and, dilating into a sinus, enters the subclavian. It has a valve at its extremity, and one in the middle; and often an intermediate one (Struthers). In rare cases the vein is absent, and its tributaries then join a large temporo-facial trunk, which accompanies the external carotid artery. It may receive, as additional branches, the occipital, the lingual, and the cephalic, and has sometimes been found to pass in front of the clavicle. These varieties should be remembered in operations at the lower part of the posterior triangle—*e.g.*, in tying the subclavian. Comminuted fractures of the clavicle may injure the external jugular or cephalic veins. Phlebotomy is now seldom practised from this vein, on account of the danger which may arise from the sucking of air into the vessel. The incision is made parallel to the vessel and across the fibres of the platysma, which, by its contraction, keeps the wound conveniently open.

Anterior Jugular, β .—A small vein, beginning near the middle line under the chin, passes obliquely downwards and outwards to the lower part of the anterior border of the sternomastoid, and, dipping beneath this, runs outwards to join the external jugular or the subclavian itself. It communicates with its fellow of the opposite side by one or two cross branches.

NERVES.

The cutaneous nerves of this region are derived altogether from the cervical plexus.

Passing obliquely upwards and forwards over the sterno-mastoid, from about the middle of its posterior border, are the *great auricular*, 1, and the *small occipital*, 2; these are beneath the deep fascia. The *superficial cervical*, 3, appears round the border of the muscle a little lower down, and runs nearly transversely across the neck. About half-way across the muscle it perforates the deep fascia; and some twigs, which are represented in the drawing as leaving the lowest branch at the point where it makes a sharp angle, pass through the platysma and ramify on its upper surface. The greater part of the nerve passes forwards at about the level of the hyoid bone, and joins one or more branches of the facial—8, 8. Branches for the skin of the shoulder and front of chest are shown at 4, 4, 5, 6, and 7.

FIG. 2

Shows in detail the structures which are covered by the sterno-mastoid.

To make the dissection, all that is necessary is to remove the sterno-mastoid and that part of the deep cervical fascia which forms the posterior part of its sheath, together with the deeper portions of fascia which cover the subjacent muscles, as well as the sheath of the vessels, and a variable quantity of fat which fills up rather deep hollows above and below the tendon of the omo-hyoid.

Thoracic Duct, †.—Beneath the clavicular head of the sterno-mastoid, near the clavicle, is a small triangle enclosed by the edges of the thyro-hyoid, the omo-hyoid, and the clavicle, in which the termination of the thoracic duct is seen appearing from beneath the internal jugular vein, and taking a curved course downwards to the junction of this with the subclavian;

it is often double, and always joined by lymphatic trunks, which conduct the lymph from the concatenate and axillary glands.

*Lymphatic Glands, *, *.*—A large and important chain of glands (*glandulæ concatenatæ*) lies along the course of the great vessels in the neck. They form a link between a group of glands which extend across the neck above the bifurcation of the carotid, drawing their lymph from all parts of the head, both superficial and deep, and another group, situated in the posterior triangle, which are joined by the lymphatics of the axilla, as well as the superficial cervical glands lying in the course of the external jugular vein. The concatenate glands are also in communication below with the glands in the thorax. Their close proximity to the large vessels will indicate how much caution is necessary in any attempt at their removal; this has, however, been safely accomplished in some cases of lymphadenoma. Besides what may be called idiopathic affections, it is important for the surgeon to remember the variety of regions in which he may have to search for a local disease in order to explain a secondary enlargement of these glands.

Parotid Gland, ¶.—The sterno-mastoid by its anterior edge causes a deep groove in the posterior part of this gland, and thus a portion of the gland, as is here shown, lies behind the muscle. This is described as one of its deep prolongations, the other occupying part of the glenoid cavity of the temporal bone.

MUSCLES.

The muscles in this drawing are only partially exposed, and will be more completely seen elsewhere.

ARTERIES.

Common Carotid, a, and External Carotid, b.—The edge of the sterno-mastoid completely covers that part of these vessels which intervenes between the omo-hyoid and the digastric, but it will not be forgotten that this represents a small part only

of the course of each. Below the omo-hyoid the jugular vein is lying on the surface of the artery.

The only branches of the external carotid exposed are a small piece of the *occipital*, *g*, on the occiput, and its *sterno-mastoid branch*, *h*, which is constant and of considerable size; the origin of the *superior thyroid*, *c*, and its small *sterno-mastoid branch*; a *hyoid branch*, *d*, from the lingual, which is sometimes replaced by a similar branch from the superior thyroid; and lastly, the *sterno-mastoid branch*, *e*. This is tolerably constant, but varies in size with the branches to the muscle from the occipital and superior thyroid. It enters the muscle at about the junction of its upper and middle thirds with the spinal accessory nerve, after having, like the corresponding branch from the occipital, passed over the hypoglossal nerve, 12.

Of the branches of the subclavian, the *superficial cervical*, *i*, and the *supra-scapular*, *j*, are seen crossing the anterior scalenus below the tendon of the omo-hyoid. The transverse cervical, as will be afterwards seen, is arising from the second part of the artery.

The *ascending cervical*, *f*, artery, a branch of the inferior thyroid, leaves this vessel as it turns beneath the sheath of the vessels (fifth cervical vertebra). It runs up between the rectus capitis anticus major and the anterior scalenus, and supplies muscular, spinal (to cord and vertebræ), and also sometimes small cutaneous offsets.

VEINS.

The *Internal Jugular Vein*, *a*, from this aspect, covers a large part of the artery on the left side. In the description of the dissection of the front of the neck (Plate 4), the general arrangement of the veins and the different relations on the two sides will be described. The branches which are seen to join the internal jugular are the *superior thyroid*, β , and the *common facial vein*, γ .

The *external jugular*, δ , is seen as it emerges from the parotid gland, and as it sinks behind the clavicle to join the subclavian. The *anterior jugular*, ϵ , is shown as it is piercing the deep fascia. It afterwards passes outwards beneath the clavicle, to join the external jugular.

NERVES.

Of those shown in Fig. 1, there remain a part of the *great auricular*, 3, passing into the parotid gland, and the junction of the *superficial cervical*, 5, with the *facial*, 11, 11.

The *spinal accessory*, 1, has been dissected out from the sterno-mastoid, which it pierces, as described at page 4. Its branches to the muscle have been cut.

The lower part of the *cervical plexus* is here shown. It is divided, like the rest of the plexus, into an internal and external series. The branches of the external series, as at present seen, are as follows:—2 is the cord formed by the *second* and *third* nerves, while below another loop is formed by the junction of the *third* with the *fourth*, 6. From the former are given off the *great auricular*, 3, and the *small occipital*, 4; and from the latter some unnamed branches to the skin over the posterior triangle, and by one or more trunks, 9, the branches for the supply of the upper part of the front of the chest and the shoulder, called *acromial*, *clavicular*, and *sternal*. It will not be forgotten that these branches supply the skin to the level of the nipple, and that accordingly in injury of the spinal cord at the lower part of the neck, sensation will probably remain in this region, although the arms may be more or less completely paralysed. In this external series are included a branch from the second nerve to the sterno-mastoid, which joins the spinal accessory; one from the third to the levator anguli scapulæ, which it enters in the posterior triangle, and one from the fourth to the trapezius. The two last cannot be recognised in this dissection.

The only branches of the internal series shown here are the

phrenic, 8, which comes from the fourth nerve, and is joined by a branch from the fifth, and often from the third. It rests on the anterior surface of the anterior scalenus; lower down it is joined by the nerve to the subclavius, and a separate branch from the trunk formed by the fifth and sixth nerves.

Communicantes Noni, 7, 7, come from the second and third nerves (in this case third and fourth), and passing either over or under the internal jugular vein, join the descendens noni. Here they were even larger than the descendens noni itself. The variation in size of these branches with reference to the descendens noni will not be wondered at, if it be remembered that the latter is essentially in all probability a branch of the first and second cervical nerves, and only associated by accident with the hypoglossal. This latter fact is indicated by its occasional association, in part or altogether, with the vagus instead of the ninth nerve.

Besides the nerves here described, there are small branches from each loop to the anterior recti muscles, and numerous communications with the deep nerves close to the jugular foramen.

Brachial Plexus.—One branch only is seen, 10.

Hypoglossal, 12.—The trunk of the nerve is just visible as it winds round the sterno-mastoid branch of the external carotid; it afterwards lies beneath the common facial vein. The little *nerve to the thyro-hyoid*, 13, leaves it near the great cornu of the hyoid bone, and descends obliquely forward to the muscle it supplies. The *descendens noni*, 14, 14, of which there are here two branches, was, as often happens, beneath the jugular vein, instead of, as is usually described, superficial to the sheath of the vessels. The so-called *ansa hypoglossi* consists of the junction of this with the communicantes noni.

Superior Laryngeal, 15.—From the vagus; lies deeply, internal to the carotid vessels in its course towards the thyro-hyoid membrane.

PLATE 2.

FIG. 1.

THIS dissection was principally intended to show the course of the vertebral artery. In order to obtain it from the last several structures were removed.

The splenius, B, and the first head of the levator anguli scapulæ, E, with the greater part of the cervical plexus, were taken away, exposing the trachelo-mastoid, C, a small piece of the complexus, D, and the extremities of the muscles attached to the transverse process of the atlas. The trachelo-mastoid was then partly removed, and afterwards the superior oblique altogether and the inferior oblique in part, and the structures beneath them cleaned.

The parotid was turned up, and the posterior belly of the digastric cut away. The omo-hyoid, sterno-hyoid, and sterno-thyroid were partly removed. A large portion of the carotid vessels and internal jugular vein were taken away, with the vagus nerve; but the cut ends of all are shown. The rectus capitis anticus major was cut at the same level as the vessels, and removed.

The inner end of the clavicle and costo-coracoid membrane were taken away, the clavicular head of the pectoralis major being cut at the same time, and also the anterior scalenus and phrenic nerve.

Lastly, the anterior inter-transverse muscles were removed, so as to expose the vertebral artery and vein in their course through the foramina in the transverse processes.

The student will easily gather, by comparing this plate with the last, in what manner a dissection might be made to expose the vertebral artery from one end to the other. He

will not forget that many of the steps here detailed would be unnecessary.

The *mastoid process*, ¶, is now fully exposed. Below it is seen a hollow, from which has been cleared away the insertion of the superior oblique muscle. The tip of the mastoid process corresponds very closely with the *transverse process of the atlas*, ×, which is almost immediately below it when the face is looking forwards; but their mutual relation varies somewhat with the position of the head. It can easily be felt with the finger. It will be noticed that the transverse process of the atlas is in a line considerably anterior to that of those of the other vertebrae. This is still more marked in Fig. 2, where the *posterior transverse processes* and *inter-transverse muscles*, V, V, are shown.

The side of the left lobe of the *thyroid body*, +, and the *trachea*, + +, are better seen in the dissections of the front of the neck. The thyroid body was here of rather small size.

A small portion of the *œsophagus*, Fig. 2, E, is often seen in such a dissection as the present. The opening of this tube by *œsophagotomy* has occasionally to be practised for the extraction of foreign bodies, &c. The first steps of the operation are similar to those for ligaturing the common carotid; after which, the large vessels are drawn outwards, and the trachea and thyroid gland inwards. The presence of these large vessels and the flaccidity of the tube, as well as the looseness of the connexion between the mucous and muscular coats of the *œsophagus*, render this operation a difficult one. Two structures to be carefully avoided are the inferior laryngeal nerve and the inferior thyroid artery. It should be remembered that, on rare occasions, the *œsophagus* may be more to the right than left side, and also that one of the large branches of the aorta may pass from left to right, between the *œsophagus* and the vertebral column.

MUSCLES.

None of the muscles are in this preparation completely exposed.

Splenius, B.—The parts covered by the insertion of the splenius capitis may now be easily observed if the reader will fill in in imagination the trachelo-mastoid and the three muscles attached to the transverse process of the atlas. The very difficult relation to understand that exists between the splenius colli and the levator anguli scapulæ will be made out by comparing this with Fig. 2. The splenius colli is attached to the vertebræ behind the levator.

The side view of the digastric, and its relation to the stylohyoid, can be seen by comparing this with Plate 1, Fig. 2.

Pectoralis Major, U, V.—A small piece of the clavicular head of this muscle, V, has been removed, in order to show the subclavian muscle.

ARTERIES.

Subclavian.—The connexions and branches of this vessel are shown in the two figures, the former principally in the first, and the latter in the second. For the sake of convenience, reference is made to both drawings in the following description.

The *left subclavian* is divided into two parts, a thoracic and a cervical. The latter begins opposite the left sterno-clavicular articulation, and takes an arched course in the neck, the highest point of which is $1\frac{1}{4}$ inch above the level of the first rib, or $\frac{1}{4}$ of an inch above that of the clavicle, and it ends by descending to the lower border of the first rib, Fig. 2, when it takes the name of axillary.

For the sake of description it is divided into three stages, the first internal to the anterior scalenus muscle, Fig. 1, G, the second between this muscle and the middle scalenus, Fig. 1, F, Fig. 2, F, and the third reaching from the edge of the anterior scalenus to its termination.

The *first part* has in front of it, besides the integument, platysma and deep fascia, the sterno-clavicular articulation and

the sterno-mastoid muscle, which has been removed, and beneath which are the anterior jugular vein, the origins of the sterno-hyoid and sterno-thyroid muscles, Fig. 1, N and O, the internal jugular vein, Fig. 1, β , the commencement of the innominate, Fig. 1, α , Fig. 2, ϵ , and the vertebral vein, Fig. 1, ϵ .

The thoracic duct, ||, also winds over it, the phrenic nerve usually crosses the artery near the inner edge of the anterior scalenus, the vagus nerve is in contact with it in the chest, and branches of the sympathetic surround the trunk.

Behind it, at a little distance, are the longus colli muscle, and branches of the sympathetic nerve.

To the inner side are the œsophagus, Fig. 2, $\mathcal{C}$, trachea, Fig. 2, + +, and the thoracic duct, Fig. 2, ||.

To the outer side is part of the pleura, Fig. 2, †.

The *second part* is in contact in front with the anterior scalenus, Fig. 1, G, on the surface of which are the phrenic nerve, the superficial cervical artery, the sterno-mastoid and integuments. Behind, it rests upon the middle scalenus, Fig. 2, F, and the first dorsal nerve, Fig. 2, 19. Above it is the junction of the two scalene muscles, and below it the pleura, Fig. 2, †. The vein is now altogether below and anterior to the artery.

The *third part* is situated in the clavicular portion of the posterior triangle. It has in front of it at first only the platysma and cutaneous structures, but at its termination the clavicle, the subclavius muscle, Fig. 1, W, and supra-scapular artery, Fig. 1, i . It is crossed by the nerve to the subclavius, Fig. 1, 17, and cutaneous branches of the cervical plexus, as well as by the external jugular vein, Fig. 1, γ , which often here forms a plexus with branches corresponding to the supra-scapular and transverse cervical arteries.

It rests upon the first rib and the first digitation of the serratus magnus, Fig. 2, G.

Upon the outer side is the brachial plexus, Fig. 1, 16,

Fig. 2, 26, the cord formed by the last cervical and first dorsal being in immediate contact with the vessel.

To the inner side is the subclavian vein, Fig. 2, *a*.

It will be readily understood from a study of the figure that the exact position of the structures in relation with the third part is open to a different description. Thus the vein might almost as correctly be said to be below, and the brachial plexus above, while the first rib is really rather to the inner side than behind.

The projection of the pleura into the arch of the subclavian is of importance surgically. It may be injured in wounds at the root of the neck, and is exposed to some slight risk during ligature of the subclavian. The *ligature* is generally applied to the third part, from which no branch arises in most cases, though it is far from uncommon for the transverse cervical to do so. The skin is drawn down and an incision of about three inches is made over the clavicle, and then after dividing the platysma and fascia it is carried deeply through the cellular tissue of the posterior triangle, the external jugular vein being in the meantime carefully avoided until the edge of the anterior scalenus is felt. The tubercle on the first rib to which it is attached, and which is indicated by a slight shading in Fig. 2, is the guide to the vessel. The plexus of veins formed by the external jugular, and the branches joining it, is often the cause of some difficulty during the operation. Fig. 1 shows what a dangerous undertaking the application of a ligature to the first part must necessarily be.

The branches of the subclavian are as follows. From the first part—

The *Vertebral*, Fig. 1, *n*, Fig. 2, *j*, springing from the upper and back part of the artery, passes almost vertically upwards behind its own vein to the foramen in the transverse process of the sixth cervical vertebra. It runs upwards through the series of foramina as far as the second, when it passes outwards to enter the foramen in the prominent

transverse process of the atlas, after which it makes a sharp turn downwards and inwards in the groove on the posterior arch of this bone. Here it lies deeply in the sub-occipital triangle, and pierces first the occipito-atloid ligament, and then the dura mater. As it approaches the middle line it makes another sharp turn forwards, and later inwards, to meet its fellow of the opposite side at the lower border of the pons where the two unite to form the basilar. In the first part of its course it lies deeply behind the internal jugular and its own veins, and is covered by the inferior thyroid artery, and on the left side by the thoracic duct. As it passes through the vertebræ its own vein still is in front, and the nerves, with the exception of the first, come out behind it. On the arch of the atlas it is partly beneath the superior oblique, and partly between this and the inferior oblique muscle; the first nerve divides between it and the atlas, and its posterior branch, the sub-occipital, Fig. 1, 7, Fig. 2, 20, appears below the vessel. It gives branches to the spinal column and cord, and others to the muscles as it ascends; in the sub-occipital triangle it gives one or more branches to the muscles in that region which anastomose with the occipital, and finally within the dura mater it supplies the anterior and posterior spinal, the posterior inferior cerebellar, and a small posterior meningeal.

The surgical interest of the artery is not great. It has been occasionally wounded by stabs, with the result of producing a traumatic aneurism, which may be readily mistaken for one of the internal carotid artery. This accident is most liable to occur near the mastoid process, where the vessel is comparatively superficial. Ligature of the artery has been practised. It will not be forgotten that these two vessels, the vertebral and internal carotid, so close in relation to one another, and so nearly equal in size, each supply respectively about half of one side of the brain. It appears certain that the sudden obstruction

by ligature or otherwise of two out of the four vessels supplying the brain is not consistent with life, though a case is on record in which a person has lived some time after all four have been gradually occluded. It is important to bear this in mind in planning a distal operation for aneurism at the root of the neck. The vertebral may arise from the arch of the aorta, or rarely from the right common carotid.

Internal Mammary, Fig. 2, *i*, arises from the lower part of the vessel just beyond the vertebral, and passes downwards and forwards between the pleura and the rib cartilages. It is crossed by the phrenic nerve, and lies to the outer side of its vein. Small perforating cutaneous twigs and the commencement of the intercostal branches are shown in the plate.

The *Thyroid Axis*, Fig. 2, *k*, arises close to the edge of the anterior scalenus. It is a short, thick trunk, which divides almost immediately into the three following branches:—

The *Inferior Thyroid*, Fig. 1, *m*, Fig. 2, *l*, runs vertically upwards outside the common carotid artery to the level of the fifth cervical vertebra; it then crosses beneath the sheath of the vessels lying upon or beneath the middle cervical ganglion, and, reaching the thyroid body, it divides into ascending and descending branches; the former supply a laryngeal branch, the latter a branch which runs downwards on the trachea, supplying it and the œsophagus, and another which unites with a similar branch from the opposite side under the cricoid cartilage. From the ascending part of the inferior thyroid rises the ascending cervical, Plate 1, Fig. 2, *f*, which has been before seen. The inferior thyroid is usually the largest branch of the thyroid axis, but it varies in size in relation with that of the opposite artery and the superior thyroid and deep cervical arteries.

The *Supra-scapular*, Fig. 1, *i*, Fig. 2, *m*, runs at first downwards, and then downwards and outwards behind the clavicle, usually in front of the anterior scalene, but sometimes beneath

it towards the supra-scapular notch, when it winds over the supra-scapular nerve and sends forward a small twig to the venter of the scapula. It then runs above the supra-scapular ligament into the supra-spinous fossa, to which it supplies a branch, and ends by passing external to the spine of the scapula into the infra-spinous fossa. It gives a small cutaneous twig over the middle of the clavicle, and others to the subclavius and side of the chest, and a considerable branch over the acromion supra-acromial. It anastomoses with the acromio-thoracic, and with the posterior scapular and sub-scapular.

The description of the remaining branch of the thyroid axis varies greatly in different books—the following is almost identical with that of Henle ("Handbuch der Gefäßlehre des Menschen," 1868, pp. 129, 130). It agrees most closely with my own experience, and is that which was found in both the subjects from which the dissections of the neck for this work were made.

Superficial Cervical, Fig. 1, *j*, Fig. 2, *n*, runs directly outwards over, or rarely under, the scalenus anticus to the edge of the trapezius; it supplies ascending and descending branches, some of which are cutaneous; the others supply the trapezius and rhomboids, serratus posticus superior, and levator anguli scapulæ, and anastomoses with the occipital, the ascending and deep cervical, and the transverse cervical and supra-scapular; some run downwards with or near the spinal accessory nerve.

Transverse Cervical, Fig. 1, *k*, Fig. 2, *o*, arising from the third or from the second part of the artery, passes outwards behind the anterior scalenus, and usually between two cords of the brachial plexus (fifth and sixth, or sixth and seventh) to the upper and inner angle of the scapula. Here it divides into a small upper branch, which anastomoses with the arteries before mentioned, and a larger descending one, usually called the *posterior scapular*, which runs down the

internal border of the scapula between the rhomboids and the serratus magnus, sending branches to the dorsum and venter of the bone and the surrounding muscles.

The other most common arrangement is when one large branch, called the *transverse'cervical*, leaves the thyroid axis, and divides into the *superficial cervical* and the *posterior scapular*.

The only remaining branch of the subclavian is the *superior intercostal*, Fig. 2, *p*. This leaves the artery behind the anterior scalenus, and at once turns backwards over the first rib lying between the inferior cervical ganglion, Fig. 2, 10, and the first dorsal nerve, Fig. 2, 19, and then downwards into the thorax, where it occupies an analogous position to the aortic intercostals in the first two intercostal spaces. As it turns downwards it gives off the *deep cervical*, Fig. 1, *l*, Fig. 2, *q*, which runs upwards and backwards between the transverse process of the last cervical vertebra, Fig. 2, *κ*, and the neck of the first rib, and, continuing its course, lies on the semi-spinalis muscle beneath the complexus, and anastomoses with the ascending cervical, the descending branches of the vertebral, and the princeps cervicis from the occipital. The analogy of this artery with the intercostal branches is obvious; besides supplying the muscles in contact with it, it gives twigs into the spinal canal through the intervertebral foramina and external branches to accompany the posterior cervical nerves.

We now return to the description of Fig. 1 alone.

VEINS.

The formation of the *innominate vein*, *a*, takes place immediately behind the sterno-clavicular articulation by the junction of the *internal jugular*, *β*, and the *subclavian*, *δ*. At the angle formed by the junction of these veins the thoracic duct *||*, and the vertebral vein, *ε*, enter, the latter having pre-

vously received branches corresponding to the ascending cervical (external vertebral) and deep cervical veins. At a variable point beneath the sterno-mastoid the subclavian vein receives the *external jugular*, γ , which has already united with the anterior jugular and the supra-scapular, superficial cervical, and transverse cervical veins. In this case a large vein entered the subclavian from the arm, occupying the position of the cephalic.

The *vertebral vein*, ϵ , is not of a size corresponding to the artery, as the blood from the cerebral branches is returned by the sinuses of the dura mater to the internal jugular. It receives numerous muscular and spinal branches as it descends, and often sends a small branch through the foramen in the transverse process of the seventh cervical vertebra. The inferior thyroid vein descends to the innominate.

NERVES.

In front of the transverse process of the atlas is seen the lower part of the *inferior ganglion* (ganglion of the trunk) of the *vagus*, 1, from which a small cardiac branch, which has been cut, is taking origin. Leaving the ganglion in front is the *hypoglossal* nerve, 19, which, it must be remarked, is in the drawing a little too high. It hid the lingual artery completely in this preparation. The position is apt to vary in the dissected subject. Behind the ganglion is the *spinal accessory* nerve, 5.

On the thyro-hyoid membrane is the *superior laryngeal*, 2, a branch of the *vagus*; and below it, on the inferior constrictor, the *external laryngeal*, 3, a branch of the same, which supplies a pharyngeal branch, and runs forward to supply the crico-thyroid muscle, Fig. 2.

Appearing from beneath the carotid vessels is the lower part of the *superior cervical ganglion*, 21, of the sympathetic, and running down behind the sheath of the vessels is the cord

which connects this with the middle ganglion and a cardiac branch (the superficial cardiac), which ultimately joins a similar branch from the middle ganglion, and passes into the chest, in front of the subclavian and arch of the aorta. The *middle cervical ganglion*, 23, is opposite the fifth cervical vertebra, behind or upon the inferior thyroid artery. It gives off a cardiac branch (nervus cardiacus magnus vel profundus), and another which connects it with the inferior ganglion, and it usually communicates with the fifth and sixth nerves.

The arrangement of the *cardiac nerves* is very variable. The right superficial cardiac passes behind the aorta. On both sides it joins the external and inferior laryngeal nerves. The middle may leave the sympathetic cord in cases where the middle ganglion is small, or absent. It often unites, as in Fig. 2, with the upper and lower nerves into a plexus round the subclavian artery, in which it is impossible to distinguish one from the other.

The *lower cervical ganglion* is shown at Fig. 2, 10, but only in part, lying on the neck of the first rib; it is behind the vertebral artery. It receives a branch from the middle ganglion, and sends inwards a large cardiac branch, which often unites with the great cardiac, and passes behind the subclavian to the deep cardiac plexus. It communicates with the seventh and eighth cervical nerves, and sends a large plexus upwards along the vertebral artery.

The exit of the cervical nerves from the intervertebral foramina, the formation of the brachial plexus, and the close relation of the latter when formed to the subclavian artery, as well as the small nerve to the subclavius, and two branches coming through the middle scalenus, are shown in this drawing. They will be referred to again under the description of the brachial plexus.

Attention is particularly directed to the relation of the first two cervical nerves to the vertebral artery. The *first nerve*

divides into anterior and posterior branches beneath the vertebral artery, the posterior or *suboccipital*, 7, passing out behind, divides into twigs, which supply the muscles in the suboccipital triangle, and often joins the second, 9. The anterior branch, 6, runs internal to the artery forward beneath the rectus capitis lateralis, which it supplies, and passing downwards in front of the first anterior inter-transverse muscle, joins the anterior branch of the second. The *second nerve*, dividing between the arches of the first two vertebræ, sends its posterior branch (*the great occipital*), 9, backwards and downwards over the obliquus inferior, H. The anterior branch, 8, is pushed outwards by the projection of the vertebral artery, so that it appears to lie external to this vessel, whilst it really occupies a position behind it, like the anterior branches of the lower cervical nerves. It then unites with the anterior branch of the first, forming a loop with it, from which communicating and muscular branches are supplied, and sends downwards a branch which unites into a similar loop with the third nerve, which has been previously described. All the other nerves pass out behind the vertebral artery, and so between the anterior and posterior inter-transverse and the scalene muscles.

The accompanying woodcut will explain better the mutual relation of the two nerves to the vertebral artery. The loop between their anterior branches is in close relation with the ganglia of the sympathetic and vagus. It supplies muscular branches to the rectus capitis anticus major and minor, and connecting filaments to the hypoglossal, pneumogastric, and sympathetic.

The posterior branches of the first five nerves are shown in Fig. 2. They pass out between the complexus and semispinalis, and unite to form what is sometimes known as the *posterior cervical plexus*. Each sends an internal and external branch, of which the former are muscular and cutaneous,

and the latter muscular only. They supply all the muscles at the back of the neck, and the skin of the back of the neck and scalp.



A Obliquus inferior. B Rectus capitis lateralis. C, C Rectus capitis anticus minor. D, D Inter-transverse muscles. E Obliquus superior (which has been detached from the transverse process of the atlas).

1, 1' Anterior and posterior branches of first cervical nerve. 2, 2' Anterior and posterior branches of second. 3, 3' Anterior and posterior branches of third. α, vertebral artery.

The sixth, Fig. 2, 25, seventh, and eighth pass beneath the semi-spinalis, and are purely muscular.

FIG. 2.

The object of this dissection was to show the cervical part of the subclavian artery in the whole of its extent, with all its branches, but especially to display the deep cervical artery.

In making this dissection from the last the skin was reflected a little further in all directions except above.

At the anterior part the parotid gland was cut away at the level of the incision in the skin. The vessels were all shortened, and the digastric still further removed. The sterno-hyoid, sterno-thyroid, and omo-hyoid were completely cleared away, and the edges of the right sterno-hyoid and sterno-thyroid were brought into view.

At the lower part the clavicle was further shortened, and the subclavius and part of the pectoralis major were removed. The intercostal fascia and the internal intercostal were then taken away, so as to expose the pleura and the internal mammary vessels. Above the first rib the veins were mostly cleared away, as well as the upper four cords of the brachial plexus.

Behind, the dissection was carried very much deeper. The anterior margin of the trapezius, A, was exposed, showing at the same time the serratus magnus, G, and turned a little backwards. The splenius, B, levator anguli scapulæ, A, A, and middle and posterior scalenus, F, were then cut; and as the first was turned back, the serratus posticus superior, E, made its appearance; beneath these muscles is the prolongation upwards of the erector spinæ, D, and the complexus, C. The attachments of these muscles to the articular and transverse processes of the cervical vertebræ were removed, and on cutting the prolonged erector spinæ and throwing back the complexus, the semi-spinalis, H, was brought into view.

The projection formed by the articular processes of the fourth and fifth cervical vertebræ is marked thus *, and above and below are seen similar projections formed by those of the second and third, third and fourth, and fifth and sixth. Below this last is another projection, ¶, which is the transverse process of the seventh cervical vertebra. It will be noticed that this occupies a position considerably behind the line of the transverse processes, of which the anterior and posterior

tubercles are shown in series in front of the articular processes. On tracing this series upwards the transverse process of the first is found in a line decidedly anterior to the others, so that the inter-transverse muscles, V, V, occupy a line of which the upper end projects forwards and the lower backwards; the posterior ones alone are left, except in the first space, where the reference is placed upon the anterior muscle.

Attention is directed to the great distance of the trachea, + +, from the surface at the level of the upper border of the sternum. In a subject like that from which the drawing was made, in which the fat is well, though not extravagantly, developed, the distance is one inch and a half; it is a point that must be borne in mind in cases where it may be necessary to open the windpipe below the isthmus of the thyroid gland.

MUSCLES.

Stylo-hyoid, L, is now seen in almost its whole length. Arising from the anterior surface of the base of the styloid process, it passes downwards and forwards anterior to the carotid vessels; and after winding over the tendon of the digastric muscle, or splitting to allow it to pass, it is inserted into the upper border of the hyoid bone at the junction of the body and great cornu. It is deeply situated at first behind the parotid gland, but is quite superficial at its termination. Its action is to elevate the hyoid bone. A second muscle is not unfrequently found (*stylo-hyoideus alter*), which varies in position, but may pass behind the lingual artery and hyo-glossus, to be inserted into the small cornu of the bone; it then occupies the same position as the stylo-hyoid ligament.

The mutual relations of the muscles attached to the thyroid cartilage are here well shown. It will not be forgotten that the sterno-thyroid has been removed from the oblique line, where it is attached between the thyro-hyoid, N, and the inferior constructor, R.

The *first external intercostal*, Z, is covered by the intercostal

fascia. The fascia has been removed beyond its anterior edge, and the internal intercostal which then made its appearance, with its fibres passing in an opposite direction to those of the external, was also taken away.

The muscles at the back of the neck are only shown in part, but the reader will not fail to observe the relation of the *serratus magnus*, G, to the vessels—i.e., that while the first digitation lies under, or almost under, the termination of the subclavian artery, it does not reach the level of the vein. The position of the *serratus posticus superior*, E, and its relation to the *splenius*, B, are also to be remembered.

The *semi-spinalis colli*, H, alone calls for further remark. It is arising from the back of the articular processes of the cervical vertebræ as high as the third or fourth, and passing inwards to be inserted into the spines of all the cervical vertebræ except the atlas. It lies on the multifidus spinæ, and is crossed by the posterior branches of the second, third, fourth, and fifth cervical nerves, and the deep cervical artery. The sixth, seventh, and eighth cervical nerves pass beneath the muscle.

ARTERIES.

The subclavian and its branches are described at p. 14.

Innominate, a.—Occupies, in many cases, an almost median position, so that it is generally exposed in a dissection like the present.

Axillary, r.—The commencement of the axillary is seen over the first intercostal space, the two cords of the brachial plexus being external to it, and the axillary vein to the inner side. A branch of the *acromio-thoracic, s*, runs along the border of the pectoralis minor.

NERVES.

The description of most of the nerves is given at p. 21.

For an account of the brachial plexus the reader is referred to the description of Plate 5.

PLATE 3.

FIG. 1.

THIS dissection is intended to show the arrangement of the platysma and deep cervical fascia in the front of the neck, and to serve as an introduction to the three that are to follow.

In order to prepare it, all that has been done is to remove the skin and subcutaneous tissue over an area which is bounded below by a line drawn across the sternum at the junction of the manubrium with the gladiolus, above by the lower border of the inferior maxilla from angle to angle, and laterally by lines joining the extremities of these.

With regard to the *deep cervical fascia* nothing need be added to the description which has been given at p. 1. The manner in which it fits closely upon the thyroid cartilage, ¶, and the thyroid body, †, are indicated, and also the places at which it is attached to the hyoid bone and clavicles. The space between its most superficial and the next subjacent layer has been opened, *, disclosing the mass of fat which fills it.

Platysma, A.—The anterior edge of the muscle is here shown. The inner fibres are often, as in this case, somewhat indefinite. The most internal cross over those of the opposite side for a variable, but short, distance, below the symphysis of the lower jaw. Thus, between the two muscles is included a triangle whose apex is upwards, and corresponds nearly with the symphysis of the jaw, and whose base is downwards, and corresponds with the episternal notch. The full description of the muscle is given at p. 3.

ARTERIES.

Of the regularity of the vascular supply of this region as here depicted, I am unable to speak positively. The submental

branches of the facial sent down two large branches, *d, d*, which anastomosed with smaller ones, *b*, from the superior thyroid. From the side came in other small twigs, such as *c*, probably from the ascending cervical, or some other branch of the subclavian, while from below ascended two trunks of considerable size from the internal mammary, *a, a*, in the first intercostal space.

VEINS.

Anterior Jugular, a, a.—Beginning in a plexus below the chin, these two veins run down one on each side of the middle line, receiving lateral branches as they descend, and often, though not in this instance, intercommunicating by transverse twigs. At a variable point they sink beneath the deep fascia, when, as is seen in Fig. 2, they again intercommunicate, and, passing outwards beneath the sterno-mastoid, join the external jugular. Plate 1, Fig. 2, p. 10.

NERVES.

The nervous supply of this region is from the *superficial cervical* branch of the cervical plexus, a few terminal twigs of which are superficial to the platysma, 1, 1, while the main trunk of the nerve, Plate 1, Fig. 1, is beneath that muscle.

FIG. 2.

This dissection illustrates on the right side of the subject the amount of the anterior triangle that is seen before the structures are displaced, and on the left side what may be seen after removing the digastric, the omo-hyoid, and the sub-maxillary gland, while the sterno-mastoid still remains *in situ*. It is thus apparent that in the undissected subject the anterior triangle is very small; most of the objects which are described as existing in it are only seen in the next stage of the dissection. Plate 4, Fig. 1.

It is prepared from the last dissection by removing the platysma and deep fascia, preserving on the right side the nerves, 1 and 2, which lie beneath the muscle. The fat and cellular tissue are then to be cleared away, and after the structures seen on the right side have been cleaned, the digastric, B, and the submaxillary gland, C, and then the omo-hyoid muscle, F, are to be removed on the left side. A deep layer of cervical fascia (p. 2) must be taken away from the surface of the depressors of the hyoid bone and thyroid cartilage.

Anterior Triangle.—Whilst the parts remain *in situ* the base of the anterior triangle is the lower margin of the lower jaw from angle to symphysis, and the two triangles together form a somewhat diamond-shaped space as shown in the drawing. In the dissected subject the base is said to consist of the lower jaw from symphysis to angle, the skull and the ear, the internal border of the middle line, and the outer of the edge of the sterno-mastoid muscle. This dissected triangle is divided into two parts by the digastric muscle which cuts off a small triangle from the upper part, the apex of which is directed downwards, and corresponds to the middle of the tendon of the digastric, while the base is that of the large triangle itself. As this description is an artificial one, it will not be again referred to; the structures usually described in the anterior triangle will be found illustrated either in the following plate, or on those of the side of the neck, and the side of the head.

Larynx.—It will be noticed that in the middle line a narrow interval exists between the sterno-hyoid and sterno-thyroid muscles of opposite sides, in which the hyoid bone, the thyroid and cricoid cartilages, with the ligaments that bind them together, are seen.

MUSCLES.

Sterno-mastoid, A, A.—See and compare Plate 1, Fig. 1. The curve of the anterior edge, and its near approach to the angle of the jaw, are clearly seen.

Sterno-hyoid, G.—Arising from the back of the sternum, the clavicle and sterno-clavicular joint, and sometimes from part of the cartilage of the first rib, the muscle ascends vertically over the thyroid body and the larynx, to be inserted into the lower border of the body of the hyoid bone. It is wider below than above, and between the muscles of opposite sides is a narrow space, which becomes wider both above and below; in this interval are seen above the cartilages of the larynx and their ligaments, and below portions of the sterno-thyroid muscles and the trachea. In contact with its anterior surface are the sternum and sterno-mastoid muscle below, and the cutaneous structures, with the anterior jugular vein, above. It rests upon the sterno-thyroid and thyro-hyoid muscles. Its action is that of a depressor of the hyoid bone, and so, secondarily, of the larynx. If the hyoid bone be fixed, the muscle may come into play as an extraordinary muscle of inspiration, helping to raise the sternum and first rib.

Sterno-thyroid, H, is here only shown in part; it is more fully exposed in Plate 2, Fig. 1. It arises from the back of the sternum and the cartilage of the first rib, and sometimes from the cartilage of the second. It passes upwards, beneath the last muscle, to be inserted into the oblique line on the thyroid cartilage. It is considerably wider than the sterno-hyoid, and does not diminish much in width as it ascends; thus it projects internally to the sterno-hyoid below, and considerably externally to that muscle above. It is practically continuous with the thyro-hyoid muscle, the origin of which corresponds with its insertion; and it is often itself interrupted by a tendinous intersection. It is covered by the sterno-hyoid and omo-hyoid, and by the sterno-mastoid muscles, and rests upon the thyroid and cricoid cartilages, the thyroid body, the carotid (and on the right side the innominate artery), the internal jugular and innominate veins. The muscles almost touch below,

and slightly diverge above. The action is almost exactly like that of the sterno-hyoid, but it acts directly upon the larynx, instead of the hyoid bone.

The two muscles just described have an important relation to the region in which tracheotomy is performed. This operation will be discussed in the description of the following Plate.

Omo-hyoid, F, consists of two bellies united by a mesial tendon; the anterior, F, arises from the lower border of the hyoid bone, external to the sterno-hyoid, and is directed downwards and outwards; the posterior arises from the upper border of the scapula, behind the supra-scapular notch and from the supra-scapular ligament, and slants upwards and inwards to the tendon, but in a less vertical direction than the anterior. The tendon is bound down to the clavicle and first rib by deep cervical fascia. It is covered by the platysma only in front, then lies beneath the sternomastoid. The posterior belly is comparatively deep, but uncovered by muscle in the posterior triangle, though its origin is hidden by the trapezius. The muscle rests successively upon the thyro-hyoid and sterno-thyroid, the great vessels, the scalene muscles, and part of the brachial plexus. The action of the anterior belly is to depress the hyoid line, that of the posterior to draw forward the scapula. Both bellies, contracting together, act chiefly upon the hyoid bone.

Thyro-hyoid, I.—Arising from the oblique line on the thyroid cartilage, it is inserted into the lower border of the body and great cornu of the hyoid bone. It is a direct continuation upwards of the sterno-hyoid, and rests upon the thyroid cartilage, thyro-hyoid membrane, and the superior laryngeal artery and nerve. It is covered by the omo-hyoid and sterno-hyoid. Its action is to approximate the hyoid bone to the thyroid cartilage.

The superficial muscles in the submaxillary region are now partly exposed.

The *Digastric*, B, like the omo-hyoid, consists of two fleshy bellies and a median tendon. The anterior is attached to a depression close to the symphysis of the lower jaw, and is directed downwards and outwards. The posterior, Plate 1, Fig. 2, L, arises from a groove beneath the mastoid process, and is directed downwards and forwards. The tendon is convex downwards, and is closely bound down to the hyoid bone by fascia; it is covered, or surrounded, by fibres of the stylo-hyoid muscle. The anterior belly is covered only by the platysma, and rests upon the mylo-hyoid; it is joined to its fellow of the opposite side by fascia, and often by transverse muscular fibres. The tendon lies under the submaxillary gland, and rests upon the hyo-glossus and superior constrictor. The posterior belly lies underneath the parotid gland, and the origin of the sterno-mastoid and splenius, and insertion of the trachelo-mastoid, and rests upon the external carotid artery, the jugular vein, and the transverse process of the atlas, with the muscles arising from it.

The action of the anterior belly is to depress the jaw, that of the posterior to move the head backwards. Both bellies acting together might possibly raise the hyoid bone.

Mylo-hyoid, D.—With a broad origin from the mylo-hyoid ridge on the inner surface of the lower jaw, the muscle descends, to be inserted by a narrow attachment to the middle of the anterior surface of the body of the hyoid bone. The muscles of opposite sides are united in the middle line, and a few fibres of one muscle often pass, as in the present instance, transversely across those of the opposite side.

On its anterior surface are the platysma and digastric, the submaxillary gland, and the submental vessels. It rests upon the hyo-glossus, stylo-glossus, genio-hyoid, and genio-hyo-glossus muscles (*vide* Plate 4, Fig. 1), the deep part of the submaxillary and the sublingual gland, Wharton's duct, and the gustatory nerve. It acts as an elevator of the hyoid bone or a depressor of the jaw.

ARTERIES.

Facial.—On the right side the facial artery, *a*, is seen as it winds over the margin of the jaw at the anterior border of the masseter, *K*, and at *b* is its large submental branch. The submaxillary gland has been removed on the left side, and the branch of the facial to it, *c*, as well as the whole of the submental branch, are shown. Above and below the hyoid bone are the hyoid branches of the lingual, *d*, that on the left side being unusually large. A small portion of each superior thyroid, *e*, *e*, is shown as it disappears beneath the sternothyroid muscle. In the middle line are two small twigs from the inferior thyroid, *g*; and appearing between the two heads of the sterno-mastoid is a small twig, *f*, from some branch of the subclavian—usually the supra scapular.

VEINS.

The description of the common facial vein will be best given with that of the next Plate.

The lower part of the anterior jugular, β , and the transverse branch which usually unites the two in this position, are shown. These will be referred to again in discussing the operation of tracheotomy.

NERVES.

The nerves in this region have been before seen—Plate 1, Fig. 1.

The superficial cervical, 1, appearing rather below the middle of the sterno-mastoid, runs inwards and upwards, sending off numerous branches, the upper of which join freely with those of the infra-maxillary branch of the facial, 2. A small piece of the hypoglossal, 3, is seen on the left side, above the hyoid bone.

PLATE IV.

FIG. 1.

THIS dissection is carried more deeply than the last, and is especially intended to show the mutual relations of the great vessels. It also shows the next stage in the dissection of the submaxillary region.

In order to obtain it from the last the sternal heads of both sterno-mastoids were cut away, and the omo-hyoids and the sterno-hyoids, and the left sterno-thyroid, were removed completely, the right sterno-thyroid only in part.

In the submaxillary region the right digastric, both mylo-hyoids, and the left hyo-glossus muscle, and hypoglossal and gustatory nerves, were taken away.

Lastly, the first piece of the sternum was cut out and taken away, with the muscles attached to it.

Lymphatic Glands.—One of the mediastinal glands, +, is shown. A number of lymphatic glands, not shown in the drawing, pass across the submaxillary region, uniting the deep series of the two sides (p. 8). They are important, because they are affected secondarily to inflammatory or malignant disease of the tongue and mouth. Myxomatous tumours, in connexion with the salivary glands and cysts (serous mucous or sebaceous) of the sublingual region, may occur in this part, rendering the diagnosis of tumours in this part sometimes difficult. In the removal of any of these it is easy to displace or remove the submaxillary gland.

The *submaxillary gland* is principally shown on Plate 3, Fig. 2, ¶. The deep part of it is here drawn, ×. It is shown in side view in Plates 1 and 2. It is disc-shaped, and consists of large flattened lobules. It is contained in a sheath of

deep cervical fascia, the upper and outer part of which, strong and attached above to the styloid process, is called the stylo-maxillary ligament, and separates this gland from the parotid. Lying below and beneath the outer third of the lower jaw, it rests for the most part on the mylo-hyoid muscle, but partly on the hyo-glossus and stylo-glossus, and overlaps the digastric in many cases. It sends a deep prolongation round the margin of the mylo-hyoid muscle, $\times$, from which is prolonged Wharton's duct.

In a groove on the posterior surface and upper border of the gland is lodged the facial artery, which gives off while in this groove its glandular branches. In connexion with the deep part of the gland is the submaxillary ganglion, and above it is the gustatory nerve for a short distance, and the sublingual gland. The main part of the gland is separated from the sublingual by the mylo-hyoid muscle. The duct opens into the mouth on the side of the frænum linguæ, after being joined by some small ducts from the sublingual.

The gland is affected in mumps, and is subject to enlargements, which may be idiopathic, or may depend upon calculous or other obstructions to Wharton's duct. The entrance of the duct into the mouth is marked by a small papilla. Catheterisation or probing is easily practised, if the direction of the duct be borne in mind.

The *sublingual gland*, †, appears above the gustatory nerve, which is here seen to wind round it.

The *thyroid body*, *, belongs to the class of ductless glands. It consists of two lobes, often of unequal size, united at their lower parts by a median portion, or isthmus. The lobes are pear-shaped, with the narrow part upwards, and extend generally as high as the middle of the posterior border of the thyroid cartilage. They lie on the trachea and larynx, but overlap the carotid vessels, and usually touch the pharynx and œsophagus. The isthmus rests upon the third and fourth rings of the trachea, but varies very much in size and shape, and

may even be absent, as in some animals. In children the isthmus frequently covers the membrane uniting the trachea with the larynx, and it is not uncommon to find it actually over the cricoid cartilage. The gland is covered by the sterno-thyroid, omo-hyoid, and sterno-hyoid muscles. From the isthmus or one of the lobes a process, called the pyramidal process, is often prolonged to the hyoid bone; and from the hyoid bone are continued downwards, either to this or some other part of the gland, a few muscular fibres (*levator glandulæ thyroideæ*).

The superior thyroid artery enters it at its upper part, and the inferior thyroid at the lower. The veins are superior middle and lower, the two former joining the internal jugular, the last the innominate.

Enlargement of the thyroid gland is easily detected, because such a tumour moves up and down with the larynx during deglutition. Besides rare malignant affections, it is liable to two more or less common causes of enlargement. *Exophthalmic goitre* is a vascular swelling of the gland, associated with a spanæmic condition; it is accompanied by well-marked constitutional symptoms, and is distinguished besides by the fact that it exhibits expansile pulsation. It must be remembered that a pulsation is *transmitted* to all enlargements of the thyroid body which extend over the carotid vessels. The other common form of enlargement is called by many names—*wen*, *Derbyshire neck*, *bronchocele*, *goitre*, &c. They may be solid or cystic, or a combination of the two conditions. The cause appears to depend partly on locality and partly on diet—certain kinds of soil, and the deep, narrow valleys amongst high mountains, appearing to favour the disease. It is remarkable that goitre is often associated with one form of *cretinism*, while in another the gland is either very small or absolutely deficient. The gland has been a few times successfully removed, whilst more than one attempt to do so have proved fatal. The danger arises from hæmor-

rhage. The only safe method of performing the operation is to secure the superior and inferior thyroid arteries by strong ligatures—which include the part where they enter—passed close to the capsule before the vessels are cut; but it must be remembered that the shrinking of the tight capsule, derived from the deep cervical fascia after the removal of the gland, will be not unlikely to relax even a ligature which was at first very tightly applied; to avoid this danger, two ligatures may be passed at each point, one of which is tightened while the other is kept in reserve. Fortunately even large goitres but seldom cause much inconvenience, so that, except for the sake of remedying a deformity, this operation is not one that is often called for.

The operation of *tracheotomy* may be here shortly considered. It may be performed either above or below the isthmus of the thyroid gland. In the former case an incision one inch or more long is made below the cricoid cartilage, and in the latter above the episternal notch; and after dividing the subcutaneous and deep fasciæ it is carried more deeply in the interval between the sterno-hyoid and sterno-thyroid muscles, Plate 3, Fig. 2, avoiding such vessels as may be seen and tying such as are cut, until the trachea has been fully exposed, when it may be steadied with the finger, or better with a sharp hook held in the left hand, while with the right an incision is made from below upwards through two or three rings of the trachea. The isthmus of the thyroid gland may be pulled down or up, or even cut through without danger.

The low operation has been warmly advocated by some surgeons, and the high one by others. Cases may, of course, arise in which the former is obviously indicated; but in most instances where the obstruction is known or expected to be below the level at which the high operation would be done, any operation is counter-indicated. It is not easy to see any advantage which the low operation possesses over the high, while several difficulties and disadvantages undoubtedly exist.

1st. The trachea is at a great depth in a well-developed subject, and in the short neck of a fat child the minute tube is very difficult to find.

2nd. There is a subcutaneous plexus of veins uniting the two anterior jugulars, from which troublesome hæmorrhage may be experienced.

3rd. The thymus gland in the infant often projects far into the neck, to the serious inconvenience of the operator.

4th. The large left innominate vein, generally distended with blood, is in uncomfortable proximity to the lower end of the incision, and on each side of it are the two inferior thyroid veins.

5th. The danger from infiltration of pus behind that layer of deep cervical fascia (p. 2) which lies behind the sterno-thyroid muscles, into the anterior mediastinum is undoubtedly greater the nearer that region is approached.

No important arteries are liable to injury during the operation. Arches pass across both above and below the thyroid body, formed by the superior and inferior thyroid arteries respectively.

Laryngotomy is practised in the crico-thyroid membrane. A short longitudinal incision is made in the skin. The membrane is reached after dividing the superficial and deep fasciæ, and separating the sterno-hyoid and sterno-thyroid muscles; and is then punctured by a small transverse incision of sufficient size to admit the tube. The small crico-thyroid artery is almost necessarily divided, but its size is generally insignificant.

The *Stylo-hyoid Ligament*, =, is an indistinct band of fascia which passes from the tip of the styloid process to the small cornu of the hyoid bone. It represents a part of the series of structures developed in the second, or hyoid, of the pharyngeal plates in the fœtus. In many animals, and sometimes in man, it is ossified. The middle constrictor arises in part from it, and a band of muscular fibres (*stylo-hyoideus alter*) may run along it and apparently replace it.

Pleura.—A small portion of each pleura is here exposed; but in the normal state they would, no doubt, project nearer to the surface. It was not, however, possible in the present instance to inflate the lungs. Attention is directed to the fact that a larger portion of the left pleura than of the right is shown on removing the first piece of the sternum, and that, in consequence, the surface of the right as it is shown is more vertical than that of the left. The superior cava descends between the two.

MUSCLES

(In the Submaxillary Region).

Genio-hyoid, E.—Arising by a narrow origin from the lower of the two tubercles on the inner surface of the lower jaw, the muscle widens as it descends, and is inserted into the middle of the upper border of the hyoid bone. The muscles of opposite sides are in contact in the middle line; they are covered by the mylo-hyoids, and rest upon the genio-hyo-glossi and hyo-glossi. Their action, singly or combined, is to approximate the hyoid bone to the lower jaw. Either bone may be the fixed point from which the muscle acts.

Hyo-glossus, C, arising from the body and both cornua of the hyoid bone; the muscle ascends almost vertically to the back of the dorsum of the tongue. Here it joins with the stylo-glossus and other muscles to form a wide, inverted-slipper-shaped expansion, which covers the dorsum, sides, and tip of the tongue. In contact with its anterior or outer surface are the mylo-hyoid and digastric muscles, the submaxillary and sublingual glands, and Wharton's duct, and the hypoglossal and gustatory nerves. Beneath it are the genio-hyo-glossus, the stylo-hyoid ligament, =, and middle constrictor, the lingual artery, and the glosso-pharyngeal nerve. Above it is the mucous membrane of the mouth. Its action is to draw the edges of the tongue downwards in

opposition to the stylo-glossus, and to render the upper surface of the organ convex.

The *Genio-hyo-glossus*, D, better seen in Fig. 2, arises from the upper of the genial tubercles. Its fibres radiate forwards, backwards, and downwards; the anterior pass to the tip of the tongue, the lower to the middle of the posterior part of the body of the hyoid bone, and the intermediate ones are distributed along the upper surface of the tongue, where they blend with the fibres of the cortex. It is in relation by its anterior border with the mucous membrane of the mouth, by its lower with the genio-hyoid; its inner surface is in contact with its fellow of the opposite side, and its outer with the inferior lingualis, the hyo-glossus and stylo-glossus, the stylo-hyoid ligament, and middle constrictor, the lingual artery, the glosso-pharyngeal nerve, and the sublingual gland.

The action of the lower fibres is to protrude the tongue, of the anterior to retract it, and of the intermediate ones to flatten its upper surface. Acting as a whole, it will render the upper surface of the tongue convex.

The comprehension of the mutual relations of the structures in the submaxillary region will be facilitated by a study of a later dissection, Plate 8, Fig. 2, showing these structures in side view.

ARTERIES.

The *Innominate*, *a*, is only shown in part; its relations will be studied in connexion with the description of the thorax. It may be seen here, however, to extend from the midsternum opposite the second costal cartilages to the right sterno-clavicular articulation.

The reader will gain a good idea from this drawing of the dangers that must attend the *ligature* of this vessel. It may be done on the dead subject by making an incision along the lower third of the inner border of the sterno-mastoid, and another two inches or more along the clavicle, dividing the

sternal, or both heads of the sterno-mastoid and the sterno-thyroid and sterno-hyoid muscles. Drawing outwards the internal jugular vein and vagus nerve, and separating the innominate vein with the finger from the artery. The needle is then passed from the outer side so as to avoid puncturing the pleura, which covers the artery on this aspect.

Several varieties in the operation have been suggested. An easy method on the dead subject is by making an incision in the same direction as that for ligature of the third part of the subclavian, but longer; the *clavicular* head only of the sterno-mastoid is divided if this plan is followed out.

The *Common Carotid, b, c*, artery is longer on the left than the right side, but as only the cervical part of the former is to be now considered, the description of both may be given together. Beginning behind the sterno-clavicular articulations, they extend upwards and outwards to the level of the upper border of the thyroid cartilages, where they bifurcate into the internal and external carotids. Enclosed in a sheath, which also includes the internal jugular vein and vagus, each is in contact anteriorly with the sterno-mastoid and superior and middle thyroid veins above; the omo-hyoid and sterno-thyroid, with the thyroid body and descendens noni in the middle part of its course, and the sterno-clavicular articulation below. The left has also in front of it the jugular vein.

Behind it are the longus colli and rectus capitis anticus major muscles, the sympathetic nerve, the inferior thyroid artery, and recurrent laryngeal nerve. (Compare Plate 2.) To the outer side is the jugular vein and the vagus, and to the inner the trachea and larynx, and the œsophagus and pharynx, and the thyroid body.

The two vessels are separated below merely by the width of the trachea, but above by the much wider thyroid cartilage. They are much deeper at their commencement than at their termination. The difference between the relations of the vessels of opposite sides consists in the fact that the vein lies

in front of the lower part of the left artery, and that the vagus is distinctly in contact with its outer side, while on the right side the vein is separated below by a slight interval from the artery, in which interval the vagus is to be seen.

In *tying the common carotid* the point chosen is that opposite the cricoid cartilage, where it is crossed by the omo-hyoid muscle. An incision three inches in length, through skin and fasciæ, is made upon the anterior edge of the sterno-mastoid. On turning this out, and the upper border of the omo-hyoid slightly down, the sheath of the vessels and descendens noni nerve are reached. The sheath is to be opened at the inner side, and the needle passed from without inwards; both these precautions are taken in order to avoid the vein.

There is a dilatation of the vessel at its termination, from which arise the internal and external carotids. Nothing will be said here about the former, except that it is at its commencement external to the external carotid, but soon passes inwards and behind it.

The *External Carotid, d*, reaches as far as the level of the neck of the condyle of the lower jaw, and is continuous in direction with the common carotid. The first part of the artery is comparatively superficial, as it is covered only by the anterior border of the sterno-mastoid and the cutaneous structures. Above it passes under cover of the digastric muscle and enters the substance of the parotid gland, as will be shown in dissections of the side of the head, Plates 7 and 8. The general description of the vessel will also be given in connexion with them. The origin of the lower part of the facial and lingual arteries, and the branches of the former below the jaw, are shown here; but the superior thyroid alone will be described in detail.

Superior Thyroid, f, arising just above the commencement of the external carotid, runs at first inwards and then downwards beneath the sterno-hyoid and sterno-thyroid muscles till it reaches the thyroid body, in which it ends by numerous branches which join freely with those of the inferior

thyroid. It supplies branches to the muscles between which it passes, as well as the following:—*Hyoid*. Often very small, runs along the lower border of the hyoid bone and anastomoses with the hyoid branch of the lingual. These vessels often mutually replace one another. *Superior Laryngeal*. Enters the larynx with the superior laryngeal nerve. *Sterno-mastoid*. Runs down the anterior border of the sterno-mastoid, and so superficial to the sheath of the great vessels. This branch is often deficient when, as in this subject, the sterno-mastoid branch of the external carotid is well developed. *Crico-thyroid, g*. A very small branch, which runs along the crico-thyroid membrane, and is of importance only because it is generally cut in laryngotomy. In this case the artery of the left side came from the hyoid branch of the lingual—a not uncommon condition. In almost all cases an anastomosis exists between the two vessels.

VEINS.

Some surprise may be felt at the size of the jugular veins in this drawing. They were dissected as little as possible, and then represented accurately to scale.

The *Common Facial Vein, θ*, or temporo-maxillary, is formed near the angle of the jaw by the union of the anterior and posterior facial veins, or, as they may be called, the facial and temporal; the anterior facial communicates with the anterior jugular in front, and is formed by the union of superficial and deep branches; the superficial is the facial vein proper, and the deep come from the pterygoid plexus. The posterior facial vein communicates with the external jugular, and has also superficial and deep tributaries; the former come in part from the temporal, the latter in part from the pterygoid plexus. This pterygoid plexus is in the lower part of the temporal fossa, between the temporal and external pterygoid and the two pterygoid muscles. It receives branches corresponding with those of the internal maxillary artery, and communicates with the cavernous sinus.

The *Lingual* and *Superior Thyroid* veins may open into the internal jugular, or often, as in this instance, they join the common facial.

The *Middle Thyroid* joins the internal jugular. In this instance this vein was present only on one side, and joined the common facial.

Internal Jugular, ζ, η.—The upper part of this large vein is shown in other Plates. The difference in the relation of the lower portions to the carotid arteries is shown here. It will also be noticed that while the right passes down to join the subclavian considerably external to the sterno-clavicular articulation, the left, lying over the artery, is almost, but not quite, behind this joint. As a result of this, the right is behind the interval between the sternal and clavicular heads of the sterno-mastoid, whereas the left is more or less covered by the sternal head. It is well known to physicians that in cases of anæmia the venous hum is heard on the right side only, or much more easily there than on the left. It seems probable that the obstruction to pressure from the stethoscope, which the sternal head of the sterno-mastoid offers, is sufficient to account for this otherwise rather anomalous difference; but it may be suggested also that, whereas on the right side the vein can be pressed backwards against the spinal column, covered by the longus colli muscle, on the right side part of the pressure must be exerted upon the subjacent common carotid artery.

Left Innominate Vein, γ.—This vein is very oblique. It crosses downwards and to the right from the left sterno-clavicular articulation to the right side of the commencement of the innominate artery, where it is joined by the right innominate, β. It lies on the great trunks springing from the arch of the aorta, and is in contact with the left pleura. It receives the internal mammary, δ, superior intercostal, and inferior thyroid veins, ε. The right inferior thyroid opens usually at the point of junction of the two innominates.

FIG. 2.

This is intended to show the deepest dissection of the submaxillary region and some of the relations of the thyro-hyoid membrane. The sides of the drawing would, if filled in, be the same as in Fig. 1. In order to make it, the veins have first been taken away. In the submaxillary region, the submaxillary and sublingual glands, with the hypoglossal and gustatory nerves, were removed. On the left side the hyo-glossus, A, was almost completely removed, but the cut ends of the gustatory, 8, and hypoglossal, 7, nerves, and Wharton's duct, x, were left. All the muscles descending from the hyoid bone were then taken away, with what remained of the sterno-thyroid; and, lastly, the trachea was exposed by removing the thyroid gland.

The shape of the *hyoid bone* is now well seen; the two small cornua appear at its upper border, and the attachment of the stylo-hyoid ligament to the left one is shown. It should be noticed that the *thyro-hyoid membrane*, *, passes up behind the posterior surface of the bone to be attached to its upper border. A bursa exists between them in most cases, a cystic dilatation of which may form a tumour somewhat difficult of diagnosis. The purpose which is served by the attachment of the membrane to the upper border of the posterior, or lower surface, is an economy of space, for when the larynx is drawn up, it is enabled by this arrangement to slip behind the hyoid bone. The ligament is broad and strong, the strongest part being in the centre; under the thyro-hyoid muscles it becomes thinner, but is reinforced again between the tips of the great cornua of the hyoid bone and the upper cornua of the thyroid cartilage by strong bands of fibres, called the lateral thyro-hyoid ligaments. Its attachment below is to the upper border of the thyroid cartilage for its whole length. A piece of the membrane, as well as part of the thyroid cartilage, have been cut

away in the middle line, in order to show the *epiglottis*, ||, and the mucous membrane of the mouth, which lie in contact with their posterior surfaces. Fat and mucous glands intervene, and a considerable thickness of them has to be removed in order to expose the epiglottis as clearly as it is shown in the drawing. The superior laryngeal artery and nerve pierce the sides of the membrane.

The wound in a case of suicidal *cut-throat* is usually in the thyro-hyoid membrane, and the epiglottis is thus divided at the level at which it is beginning to expand. The vocal cords, it will be remembered, are attached about the middle of the posterior surface of the thyroid cartilage—*i.e.*, just below the level at which the cartilage has been removed in this preparation. A section of the epiglottis, as well as the vocal cords, are accordingly commonly seen in cases of cut-throat. Occasionally, however, the incision is made either through the thyroid cartilage, at a variable level, or immediately above the hyoid bone. In the former case the patient is not unlikely to escape with a trifling injury; in the latter he divides some of the origins of his lingual muscles, and runs a considerable chance of wounding his lingual artery. The danger, indeed, of wounding this is much greater than that of wounding the carotid, which, as has been said, is protected by the prominence of the larynx. It is in the rarest form of cut-throat—*i.e.*, through the trachea, that the great vessels of the neck are most endangered.

MUSCLES.

The *hyo-glossus*, A, is more distinctly shown in this than in the last drawing. On removing the submaxillary gland the mucous membrane, † †, is seen at the point where it is reflected from the cheek on to the under surface and sides of the tongue, at which level it begins to cover the surface of the *hyo-glossus*. The structures which lie beneath the *hyo-glossus* on the surface of the *genio-hyo-glossus* are displayed on the left side.

NERVES.

The two *pneumo-gastrics*, 1, 1, appear at the lower part of the neck. The difference between the relations of the nerves of the two sides to the arteries may be again pointed out. In the angle formed by the hyo-glossus, A, and stylo-glossus, B, are seen the *glosso-pharyngeal*, 6, and the *pharyngeal branch of the vagus*, 4. On the opposite side the glosso-pharyngeal alone is shown as it penetrates the fibres of the genio-hyo-glossus. The other nerves are described elsewhere.

PLATE 5.

FIG. 1.

THIS is the ordinary dissection to expose the *posterior triangle*. It is accomplished by reflecting the skin from an **area** extending half an inch below the upper border of the **clavicle**, and the same distance beyond the posterior edge of the **sterno-mastoid**, A, the anterior edge of the **trapezius**, B, and the **approximation** or meeting of these two muscles above. After **removing** the skin, the platysma is reached, beneath which **are** some branches of the cervical nerves and the external **Jugular vein** lying upon the deep cervical fascia (p. 6). The **fascia** must be removed, as well as some fat filling the **space**, when the dissection shown in the drawing will be **displayed**.

The precaution of drawing down the arm and rolling the head over to the opposite side is usually taken, as was done in this case. This renders the muscles tight, but it also gives a length to the neck which is apparently out of proportion.

The *posterior triangle* varies very much in shape. Its base is formed by a variable part of the upper border of the clavicle, usually about the middle third; but as the width of both **sterno-mastoid** and **trapezius** is liable to great variation, the base may be in some cases very small, or even absent, in which case there is, of course, little or no triangle. These two muscles form respectively the anterior and posterior sides of the triangle, and their approximation above represents its apex. Again, the width of the insertions is in some subjects much greater than in others, so that while the apex is occasionally quite acute, it is in others truncated. When this occurs, and the **splenius**, D, is also a narrow muscle, a portion of the **complexus**, C, makes its appearance in the floor

of the space. The triangle is divided into two parts by the posterior belly of the omo-hyoid, H; or rather, this muscle cuts off a very small portion from the lower part of the triangle. Here, again, there is great variation. The omo-hyoid may be lower, and the clavicle higher than usual, in which case the lower or clavicular portion is reduced to very small dimensions; but, on the other hand, the opposite condition of things may exist, under which circumstances it bears a larger proportion to the upper or occipital. The triangle is roofed in by a layer of cervical fascia (p. 2), which sends down septa between the muscles entering into the formation of its sides and walls. The floor consists of the following muscles, which are only seen in part:—a very small portion of the complexus, C, sometimes, though not always, shows at the upper part; then the splenius, D, levator anguli scapulæ, E, and middle scalenus, F, follow in order; quite at the base is the first digitation of the serratus magnus, I; the extent to which this is exposed being liable to great variation. If the sterno-mastoid be in the least displaced, the outer edge of the scalenus anticus, G, is seen. It is shown in the present drawing, though it must be remembered that in a carefully-dissected part it should be altogether hidden by the sterno-mastoid.

More or less fat fills the hollow of the triangle, in which are discovered the following structures:—

ARTERIES.

The third part of the *subclavian*, *a*, just reaching above the clavicle, and more or less clearly seen as the omo-hyoid takes a high or a low position. Immediately behind the clavicle may be felt, but hardly seen, the *supra-scapular*; and above the omo-hyoid are the *superficial cervical*, *b*, and *transverse cervical*, *c* (*vide* p. 19); and higher still, running over the middle scalenus, are branches of the *ascending cervical*, *d*. At the apex of the space the *occipital*, *e*, may or may not be seen;

this depends on the same causes which influence the appearance or not of the complexus.

VEINS.

The only veins are the *external jugular*, *a*, with its various tributaries corresponding to the supra-scapular, transverse, and superficial cervical arteries. This usually passes over the omo-hyoid, but not unfrequently behind it, as in the present instance.

NERVES.

At the upper part the *great occipital*, 13, is sometimes seen, and the *spinal accessory*, 8, runs obliquely across the space about the middle. Appearing from behind the sternomastoid are the various branches of the cervical plexus, which we have before traced to the edge of that muscle (p. 10)—viz., the *small occipital*, 1, *great auricular*, 2, the *superficial cervical*, 3, the *sternal*, 4, *clavicular* and *acromial* branches, 5, branches to join the *spinal accessory*, and others to supply the *trapezius* and the *levator anguli scapulæ*, 7; and lastly, on the surface of the anterior scalenus, but not strictly in the triangle, the *phrenic*, 6.

One cord of the *brachial plexus*, 9, is seen above the omo-hyoid, and from this there are three branches; that to the *rhomboids*, 10, piercing the middle scalenus, the large *supra-scapular*, 11, and the small nerve to the *subclavius*, 12, crossing the subclavian artery vertically. In this case a little nerve left this cord of the plexus, and entered the serratus magnus, but this is irregular.

Lymphatic glands occupy the space in large numbers (p. 8), and receive the lymph from the back and sides of the head and neck.

The surgical operations which are performed in this space, besides the opening of abscesses and the excision of tumours, in doing which the spinal accessory nerve must be carefully avoided, are ligature of the subclavian (*vide* p. 16), and that of

stretching the brachial plexus in cases of neuralgia, tetanus, &c. There is no difficulty about this latter procedure. An incision is made, as in tying the subclavian, but smaller, and the nerves are sought above the omo-hyoid, which the surgeon must avoid mistaking for them. They are cleaned to a greater or less extent, and extended as much as may be thought desirable.

FIG. 2.

This dissection gives a general view of the *brachial plexus*. It is made by carrying an incision across the posterior triangle at the level of the upper border of the thyroid cartilage; then, vertical ones downwards along the anterior border of the trapezius and deltoid, and the posterior border of the sterno-mastoid, and continuing the last over the chest to the axillary border of the pectoralis major. The two vertical incisions are then joined by a transverse one along the anterior fold of the axilla. The upper part of the dissection is that of the lower part of the posterior triangle with the omo-hyoid removed. Below the clavicle, after removing the superficial and deep fasciæ, the pectoralis major, H, H, is cut and turned aside. This uncovers the pectoralis minor, I, I, a part of which has been taken away; and the costo-coracoid membrane with the subclavius muscle, M, which were also laid bare, were separated from the clavicle and taken away; and lastly the middle third of the clavicle—i.e., that part which corresponds to the base of the posterior triangle—was removed. A good deal of loose fat was removed from the axilla, in order that the parts might be fully displayed.

The reader must be cautioned against supposing that the position of the parts here drawn is a natural one. After the structures have been cleaned by dissection, if the arm be drawn forcibly away from the side, the nerves are separated from the vessels by a considerable distance. In this case

the cut ends of the clavicle were slightly separated from one another, but the artery remained nearly in its natural position. It was thought better to draw the structures in the position they assumed, because in this way the nerves are better displayed; the actual relation of the parts has been already shown in Plates 1 and 2.

MUSCLES.

All the muscles which are here exposed in part are described in the dissections of the neck and axilla. The general shape of the *serratus magnus*, J, should be noticed, the height to which it appears to reach in the neck after the removal of the clavicle, and the relation of the first digitation to the first part of the axillary artery.

The *pectoralis minor*, I, was carefully stitched across before the central portion was removed, so that the insertion of the muscle is at a normal distance from the origin.

ARTERIES.

This will serve as a uniting link between the descriptions of the subclavian and axillary arteries. Several branches of the former are seen (*vide* p. 14), and amongst those of the latter the trifurcation of the *acromio-thoracic*, g, and its *acromial* branch, as well as the commencement of the *long thoracic*, h.

VEINS.

The *external jugular*, δ , passes down in front of the anterior scalenus to join the *subclavian*, β ; the *cephalic* vein, γ , joins the *axillary*, α , at its termination, and several large branches enter the axillary from the axilla; the subclavian separates slightly from its artery, as the anterior scalenus muscle insinuates itself between them.

NERVES.

The *brachial plexus*.—When the arm is drawn away from the side, and at the same time pulled down, the cords of the brachial plexus are stretched as in the figure.

They may be seen and felt, under such circumstances, in a thin subject, stretching obliquely across the posterior triangle of the neck. In the dissected subject they are then separated by a considerable interval from the subclavian artery, although, as has been said, in the undissected subject, the lower cord of the plexus is in immediate contact with the vessel. The nerves which enter into the formation of the brachial plexus are the anterior branches of the *fifth*, 1, *sixth*, 2, *seventh*, 3, and *eighth*, 4, *cervical*, and the *first dorsal*, 5.

The manner in which they unite and subdivide is liable to very considerable variation: the arrangement which was found in the subject from which the drawing was made was very nearly that which is usually described as normal.

The fifth nerve receives a small communicating branch from the fourth (which is not seen), and joins the sixth, either soon after their exit from the intervertebral foramina, or, as in this instance, at the outer border of the middle scalenus. The eighth cervical and last dorsal unite between the scalene muscles, but the seventh cervical remains as a separate trunk for some distance. From this point onwards accounts vary. According to some authorities the seventh unites with the upper cord, and thus two cords are formed which lie outside the first part of the axillary artery. They each give off a branch backwards, and these unite together to form a posterior cord, while the original trunks become the inner and outer cords of the plexus. These three cords occupy the positions indicated by their names with respect to the third part of the axillary artery. Another method of describing it agrees with that here figured. Beyond the edge of the middle scalenus the three trunks formed by the fifth and sixth, the seventh, and the eighth and first dorsal, each divide into an anterior and a posterior branch. The anterior branches of the upper and middle trunks form the outer cord, the anterior branch of the lower forms the inner cord, while the three posterior trunks unite together to form the posterior cord.

Opposite the coracoid process the three cords break up into large branches for the supply of the arm, &c.

The branches are divided, for the sake of description, into two sets, those given off above and those below the clavicle.

The commencement of most of them is seen in this dissection.

The branches above the clavicle are—

The *nerve to the rhomboids*, 7, arises from the fifth nerve and pierces the fibres of the middle scalenus muscle. It runs outwards and downwards towards the upper angle of the scapula, after which it descends with the posterior scapular artery beneath the levator anguli scapulæ and the rhomboid muscles, all of which it supplies.

Nerve to the subclavius, 6, arising from the trunk formed by the fifth and sixth. This small nerve descends over the front of the third part of the subclavian artery to the subclavius muscle; it is generally connected with the phrenic, 19, and sometimes by a rather large branch.

Nerve to join the phrenic, leaves the fifth nerve under cover of the sterno-mastoid and joins the phrenic on the surface of the anterior scalenus. This, like the small nerves for the supply of the *scaleni* and the *longus colli* which arise from the lower cervical nerves in an irregular way, is not shown in this drawing.

Supra-scapular, 8, the largest branch above the clavicle, leaves the cord formed by the fifth and sixth nerves and passes downwards and outwards usually very close to the plexus itself, till it reaches the supra-scapular notch in the upper border of the scapula. Here the supra-scapular artery winds over it and over the supra-scapular ligament, while the nerve passes beneath the latter. It supplies the supra-spinatus and infra-spinatus muscles and the shoulder-joint.

Posterior thoracic, 9 (nerve to the serratus), arises by two roots from the fifth and sixth nerves; they unite in the substance of the middle scalenus, so that the nerve appears by

perforating that muscle. It lies behind the plexus and runs down on the surface of the serratus magnus, which it supplies, to the lower part of the axilla.

Of the branches given off below the clavicle, only a few are seen.

External anterior thoracic, 10.—Arising from the outer cord of the plexus, the nerve passes over the first part of the axillary artery, and enters the under surface of the pectoralis major, H. It communicates with the following nerve :—

Internal anterior thoracic, 11, 11.—Arising from the inner cord it passes forwards between the axillary artery and vein, and after being joined by a branch of the external anterior thoracic it enters the under surface of the pectoralis minor, I, which it supplies. It appears again on the anterior surface of the muscle and enters the pectoralis major, which it supplies in part.

The following branches to the arm are seen at their commencement in their natural relations to the artery :—

External cutaneous, 12 (*musculo-cutaneous* or *nervus perforans Casserii*), arises from the outer cord, and lies for a short distance external to the third part of the artery, but soon leaves it, perforating the coraco-brachialis.

Median, 13.—Arising by two heads, one from the inner and the other from the outer cords of the plexus, the nerve lies outside the third part of the axillary artery.

Internal cutaneous, 14, arises from the inner cord and lies in front (sometimes to the inner side) of the artery.

Ulnar, 15, springs from the inner cord and lies to the inner side of the artery, between it and the vein.

Nerve of Wrisberg, 16 (*small internal cutaneous*), also comes from the inner cord and lies to the inner side of the vessels; it joins with the *intercosto-humeral*, 18.

The following branches of the posterior cord are not seen without making a deeper dissection of the axilla and displacing the parts :—

Subscapular nerves.—They are three in number, and are called respectively *long*, *middle*, and *short*.

Circumflex passes round the humerus to the back of the shoulder.

Musculo-spiral.—The largest branch of the plexus lies behind the axillary artery.

A small *cutaneous branch*, 17, supplies the skin of the upper arm.

At the upper part of the drawing are several *branches of the cervical plexus*, 20, and coming from beneath the pectoralis minor is the large *intercosto-humeral*, 18, the lateral branch of the second intercostal nerve.

PLATE 6.

FIG. 1.

THE two figures of this plate illustrate the structures at the back of the neck.

The dissection for Fig. 1 was made by carrying an incision from about two inches above the occipital protuberance to the spine of the vertebra prominens, and reflecting a flap of skin on each side, included by this and two horizontal incisions for about three inches at each end of it. On the left side nothing except the superficial and deep fascia were removed; on the right side the trapezius and some of the nerves were taken away.

On the left side is shown the apex of the *posterior triangle*, but seen from a different aspect from that of Plate 5, Fig. 1; and here more of the posterior than of the anterior border appears. In this subject the trapezius and sterno-mastoid touched one another on the superior curved line, so that the apex of the triangle was acute, and not obtuse, as in the last plate. The splenius also had a wide origin, so that no part of the complexus appeared. This is the normal arrangement.

MUSCLES.

The *splenius*, C, arising from the spinous processes and ligamentum nuchæ between the sixth dorsal and the third cervical, is inserted as two muscles. The upper, *splenius capitis*, is attached to the outer part of the superior curved line of the occipital bone and the mastoid process of the temporal almost to its tip; the lower, *splenius colli*, passes beneath the levator anguli scapulæ to be inserted into the upper two or three cervical posterior transverse processes. It acts in opposition to the sterno-

mastoid of its own side, extending the head and upper part of the neck, and drawing them backwards towards its own side; it also bends the neck to the same side.

ARTERIES.

The arteries seen here are described elsewhere. At the upper part are the two *occipitals*, *a, a*, perforating the trapezius on the left, and appearing from beneath the splenius on the right (p. 77). On the surface of the sterno-mastoid are some large cutaneous branches of the *posterior auricular*, *e*. On the right side, below, are seen two branches from the subclavian, either both from the *superficial cervical*, or else the upper, *b*, from the *transverse cervical*, the lower, *c*, from the *superficial cervical*. On the left are two small cutaneous twigs, *d, d*, from the *deep cervical*.

NERVES.

The *great occipital*, 1, will be better seen in Plate 7. It perforates the trapezius with or close to the occipital artery.

The *third nerve*, 2, appears internal to the great occipital, and joins it.

The *fourth*, 3, and *fifth*, 4, appear close to the middle line, and rather below their respective vertebra.

The other cervical nerves supply no cutaneous branches.

The *small occipital*, 5, is just seen as it turns round the edge of the sterno-mastoid. It will be noticed that this and the great occipital, parts of the anterior and posterior branches of the second cervical nerve, which is the highest spinal nerve supplying cutaneous branches, here supply contiguous areas of skin. A similar arrangement is found below with the anterior and posterior branches of the first lumbar nerve.

FIG. 2.

This dissection, which shows the complexus muscle and the suboccipital triangle, was made from the last by reflecting on the right side the splenius, and on the left, after having

brought the dissection to the same stage, by reflecting the complexus and cleaning the structures underneath it.

This figure should be compared with Plate 2, Fig. 2.

MUSCLES.

The prolongation of the erector spinæ, consisting of the combined *trachelo-mastoid* and *transversalis cervicis*, is seen at G. The former is going to be inserted on the posterior part of the mastoid process, the latter to the posterior transverse processes of the cervical vertebræ from the second to the sixth. It acts as an extensor of the neck and head, and will help the splenius in rotating the head backwards, and to its own side.

The *complexus*, E, a large muscle with vertical fibres, arises from transverse and articular processes in the back and neck respectively, from the sixth or seventh dorsal to the third cervical. It is inserted between the upper and lower curved lines on the occipital bone. Its inner part, which is in contact with the ligamentum nuchæ, consists of two fleshy bellies and an intermediate tendon, the *biventer cervicis*. This inner part of the muscle has often slips of attachment to one or two of the cervical spinous processes. The action of the muscle is to extend the head.

Before reflecting the complexus the transverse process of the atlas appears beyond its outer edge with the muscles attached to it. After the muscle is taken away, the rest of the suboccipital triangle, the articular processes of the cervical vertebræ, the semispinalis muscle, and the numerous vessels and nerves are exposed.

Semispinalis, H.—See p. 27.

Obliquus superior, K, arises from the transverse process of the atlas; and, spreading out as it passes upwards and inwards, is inserted into a special depression above, or rather outside, the lower curved line of the occipital bone. It moves the head backwards.

Obliquus inferior, L, arises from the spine of the axis, and is inserted into the transverse process of the atlas. It rotates the head to its own side.

Rectus capitis posticus major, I, arises from the spine of the axis, and is inserted into a special surface below the inferior curved line of the occipital bone. The muscle covers part of the rectus capitis posticus minor. Its insertion is mostly beneath that of the obliquus superior. It extends the head and rotates it to the same side.

These three muscles bound the small *suboccipital triangle*, which, it must be remembered, is a very minute space indeed, until the muscles have been separated by dissection. After dissection it is larger than that shown in the drawing, and then not only does the suboccipital nerve come out through it with a branch of the vertebral artery, but the vertebral artery itself, the posterior arch of the atlas, and the posterior occipito-atloid ligament appear to form the floor of the space.

Rectus capitis posticus minor, J, arising from the posterior arch of the atlas, is inserted on to a special mark inside, and partly below that of the larger rectus. It simply extends the head.

ARTERIES.

For the description of the arteries shown here, the reader is referred to that of the *deep cervical*, p. 20, and that of the *occipital*, p. 77. The anastomosis between this and the *princeps cervicis*, b, and a branch of the *vertebral*, c, is well seen.

NERVES.

The description of the posterior branches of the cervical nerves is given at page 22. The arrangement of the first nerve, as there described, should be observed. Cutaneous branches, as was said above, are given only by the nerves between the second and the fifth. The sixth, seventh, and eighth pass beneath the semispinalis, and are purely muscular.

PLATE 7.

FIG. 1.

THIS drawing represents a dissection which is intended to show the superficial parts which are supplied by the branches of the external carotid, with the exception of the superior thyroid. It is the first of a series of four dissections.

The incisions by which this region was exposed were made—

1st. Along the middle line, from the occipital protuberance over the vertex and face to the hyoid bone.

2nd. From the occipital protuberance to a point a little behind and below the mastoid process.

3rd. From the anterior end of the last parallel with the anterior edge of the sterno-mastoid muscle, as far as the level of the hyoid bone.

4th. This incision was joined to the lower end of the first.

The dissection consisted simply in cleaning the parts which were exposed, and removing the deep cervical fascia covering the parotid gland and the masseter and sterno-mastoid muscles.

The *parotid gland*, †, occupies the interval between the ramus of the jaw and the sterno-mastoid muscle, and is prolonged forward by a separate lobule, the *socia parotidis*, ‖, which varies considerably in shape. In this subject it was remarkably regular. From it the duct of Stenson passes, though it more commonly leaves the gland itself, but lies close to the socia. Attention is directed to the fact that the gland does not reach up quite as high as the zygoma, *, in this instance, and that it is prolonged by a small lobe to a short distance below the angle of the jaw. It is important for the surgeon to bear in mind the position of *Stenson's duct*, so that he may avoid it in making incisions in this region.

It will most usually be found in a line between the lower part of the lobule of the ear and the nostril, though it has been described as lying in a line between the external meatus and the nostril. The transverse facial artery, *f*, lies above it, and a large branch of the facial nerve, *4*, below. It is about two and a half inches long, and perforates the buccinator on a level with the second upper molar tooth. One or two lymphatic glands have been removed from the surface of the gland; these, when enlarged, may simulate parotitis. Tumours are common in this region; they usually consist of modifications of the structure found in the gland (mixed cartilage, myxoma, and adenoid), but often appear unconnected with the gland itself.

By looking at Fig. 2, the structures will be seen which lie in the substance of the gland—viz., the external carotid artery dividing into its terminal branches, the commencement of the external jugular vein (here, however, irregular), and the facial nerve dividing into its main divisions, and giving off the posterior auricular, *2*. The gland sends inwards two prolongations—one in front of the styloid process into the glenoid cavity, and the other behind it but beneath the mastoid process.

MUSCLES.

Occipito-frontalis, B, C.—The anterior belly, B, corresponds in structure with the pale and weak muscles of the face; the posterior, C, is, on the other hand, dark and red. The external fibres of the latter pass very much forwards, so as to lie parallel with those of the *retrahens aurem*, R. Some few tendinous fibres pass downwards, crossing obliquely those of the insertion of the *sterno-mastoid*, S. The fascia is firmly connected with the skin, but very loosely with the pericranium; it is attached along the superior curved lines and to the occipital protuberance. At the sides it blends with the temporal fascia at a varying distance from the middle line. The fasciæ of the two sides are continuous, but they are more closely bound down to the pericranium between the anterior bellies than behind. The

result of the lines of attachment of this aponeurosis influences the direction in which fluid existing beneath it will burrow; in front it will form a tumour behind the orbicularis palpebrarum, while behind it will be limited by the occipital protuberance and the superior curved lines. The muscles of the ear were, in this subject, well developed, and of a very distinct shape; the *attrahens aurem*, Q, especially, is larger than usual. Both this and the *attollens aurem*, P, arise from the thin lateral prolongation of the epicranial aponeurosis, and are inserted, the former into the fore part of the helix, the latter into the back of the fossa of the antihelix.

The muscles surrounding the eye, nose, and mouth will be considered more in detail in the discussion of these particular regions. It is only necessary now to explain a few peculiarities and some details which are seen only in a general view.

Orbicularis palpebrarum, A.—The lower fibres are broad and disconnected, and lose themselves indefinitely on the surface of the levator labii superioris and levator labii superioris alæque nasi.

Zygomatici, I, J.—In this, as is often the case, there was really only one muscle, the division shown in the Plate being somewhat artificial. These muscles are liable to very considerable variation, and the smaller is often almost indistinguishable from the lower fibres of the orbicularis.

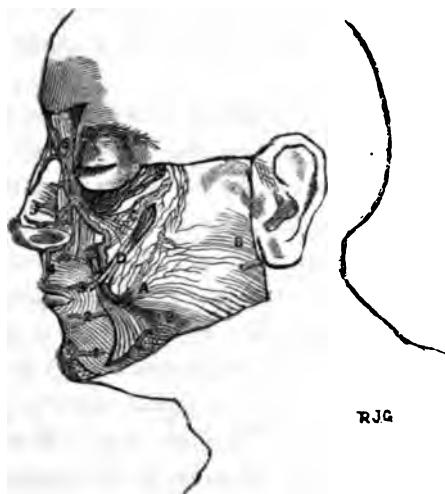
Risorius, was not to be distinguished. It consists of a few of the thin upper fibres of the platysma, and is attached externally to the fascia over the masseter, and internally to the orbicularis. The *platysma*, U (*vide* p. 3), indeed, had a very distinct upper border. Its attachment for two inches to the lower border of the jaw is well shown, and the manner in which it blends with the muscles of the mouth. The following woodcut illustrates another and more common arrangement of these two muscles.

Levator anguli oris, K.—The fibres of this muscle are

always directly continuous in direction with those of the depressor anguli oris, L.

Levator menti, N.—The insertion of this muscle into the skin of the chin is here wider than usual. It fills the triangular interval between the two depressors of the lower lip, M.

Masseter, T.—Consists of two parts, superficial and deep. The former arises from the anterior two-thirds of the lower border of the zygomatic arch, its fibres pass downwards and



A. Risorius. B. B. Platysma. C. Zygomaticus minor, apparently part of orbicularis palpebrarum, crossed by some superficial fibres of the latter, and joining the levator labii superioris. D. Zygomaticus major.

1. Inferior labial. 2. Inferior coronary. 3. Superior coronary. 4. Artery of septum. 5. Lateral nasal. 6. Angular.

backwards, and are inserted into the lower half of the outer surface of the ramus of the jaw; the latter arises from the posterior third of the lower border of the arch, and from its deep surface, and its fibres, which are short, pass downwards and forwards to be inserted into the upper half of the outer surface of the ramus of the jaw and coronoid process, and are

often united by tendinous bands with the temporal muscle. On raising the parotid gland in order to expose it, the neck of the condyle of the jaw and part of the external lateral ligament are uncovered behind the border of the masseter. The masseter simply elevates the jaw.

Sterno-mastoid, S.—(*Vide* p. 3.)

VESSELS.

With two exceptions, *b* and *c*, all those seen in this Plate are branches of the external carotid. The arteries of the face and scalp are remarkable for their tortuosity. This is most marked in the occipital, but is often very great in the temporal and others.

Occipital, *d*.—Situated midway between the occipital protuberance and the mastoid process. The artery soon divides into several irregular branches, which anastomose freely with those of the opposite side, as well as with the posterior auricular, *e*, and the temporal, *a*. A small anterior branch usually supplies the back of the ear, but in this case did not reach so far. The remainder of the vessel is seen in later dissections. The position of the vessel should be remembered by the surgeon. A divided occipital artery, if it retract into a wound of the scalp, is often very difficult to secure, and may lead to very troublesome hæmorrhage, to which a pad or acupuncture needle, accurately applied, will efficiently and at once put an end.

Temporal, *a*.—The trunk appears above the parotid gland, in front of the ear, and at a variable distance within two inches above the zygoma divides into two branches. The posterior, running backwards, anastomoses with its fellow of the opposite side, as well as with the posterior auricular and occipital arteries. The anterior is of more importance to the surgeon. It lies at the distance of about one and a quarter inch behind the external angular process of the frontal bone, and, running forwards, anastomoses with the supra-orbital and frontal. It

is the artery from which blood is taken, if the temporal artery be selected for that purpose, and it is a point to be avoided in the operation of trephining, as it lies, opposite the orbit, a quarter of an inch in front of the great anterior branch of the middle meningeal (*vide* footnote, p. 81). In this case the anterior branch was low, and reinforced the supra-orbital artery, which was here very small. The small anterior auricular branches and the middle temporal are not shown. They both leave the vessel soon after it has crossed the zygoma. The former pass back to the ear, the latter dips at once beneath two layers of the temporal fascia, sending a branch forward between the layers of the fascia to join a branch from the lachrymal or internal maxillary, and supply a few twigs to the orbicularis palpebrarum, while the greater part of it is lost in the temporal muscle anastomosing with the deep temporal arteries.

Transverse facial, f.—A branch of the temporal; varies much in size. It begins in the substance of the parotid gland, and, after emerging near its upper border, runs forward parallel to, but above, Stenson's duct, to anastomose with the facial and infra-orbital arteries.

The *facial, g*, will be described in connexion with Fig. 2. It rests here on the depressor anguli oris, instead of, as is usually described, on the buccinator only; perforates, instead of passing completely beneath, the zygomatic muscles, and passes beneath instead of over the levator labii superioris. Such varieties are common.

Posterior auricular, e.—The superficial branches are directed to the back of the ear. Some supply the back of the pinna, and, perforating the cartilage, reach the anterior surface. A large one is generally found running backwards over the insertion of the sterno-mastoid; a deeper branch runs underneath the posterior belly of the occipito-frontalis (Fig. 2). The small branch accompanying the facial nerve (stylo-mastoid), and some twigs which pass in front of the ear, are not seen.

VEINS.

Facial, a (*vide* p. 44).—Is only seen in a very short part of its course. It has nearly the same direction and relation as the artery, but is straight instead of being tortuous. It receives in this part of its course a communicating branch—the deep facial or anterior internal maxillary—from the pterygoid plexus.

NERVES.

Great occipital, 1, is the posterior branch of second cervical nerve; it has the same course and distribution as the artery it accompanies. It usually communicates with the next. For the commencement of the nerve, *see* Plate 2, Fig. 2, and Plate 6, Fig. 2.

Small occipital, 2, is a branch of the second cervical nerve. It is here large and double. It joins the great occipital, and sends a branch to the back of the ear, which joins the great auricular, and is supposed to supply the *attollens aurem*.

Great auricular, 3, is a branch of the loop between the second and third anterior cervical nerves. It runs obliquely upwards and forwards to the ear, over the sterno-mastoid muscle. Some branches pass behind the pinna, communicating with the posterior auricular, 5, and the small occipital, 2. Others pass in front, and communicate with the auriculo-temporal, 6, and with branches of the facial in the substance of the parotid gland. One of these is seen passing into the gland. It supplies the pinna and the skin in front and behind it.

Posterior auricular, 5, leaves the facial in the parotid gland. It emerges at the front of the mastoid process, and, passing backwards, communicates with the great auricular, and also with the auricular branch of the vagus (Arnold's nerve). It supplies the occipito-frontalis (posterior belly) and the *retrahens aurem, R.*

Facial, 4, is divided, for the sake of description, into two series, *temporo-facial* and *cervico-facial*. The first comprises three branches, which are shown in the drawing. Taken from above down they are as follows:—*temporal*, joining the auriculo-temporal, 6, the temporo-malar, 7, supra-orbital, 8, and lachrymal; *malar*, joining the temporo-malar and the supra-orbital and infra-orbital; *infra-orbital*, joining the infra-orbital of the superior maxillary, the nasal, and infra-trochlear of the ophthalmic. The main trunks of the lower or cervico-facial division only are seen. One small twig is shown perforating the platysma. It is more fully seen in Fig. 2.

The various branches of the facial intercommunicate with great freedom. Many more might be shown by very careful dissection. They supply all the muscles of the face, but it is needless to specify which twigs are distributed to the individual muscles.

Auriculo-temporal, 6.—The nerve itself is not shown in this dissection. After passing behind the temporal artery it supplies two temporal branches, which are distributed to the skin of the temporal region, communicating with the temporo-malar and facial. The posterior of these is the larger.

Temporal branch of the temporo-malar, 7, was in this subject of large size. It perforates the temporal fascia one inch above the zygoma, and sends twigs forwards and backwards to join the facial and auriculo-temporal nerves. The malar branch, which is not shown, appears through a foramen in the malar bone, and supplies cutaneous filaments in this region, joining with the facial.

Supra-orbital, 8, 8.—The termination of the frontal, which is a branch of the ophthalmic. It leaves the orbit at the supra-orbital notch, and running upwards, at first beneath and then superficial to the anterior belly of the occipito-frontalis muscle, supplies the skin as far as, or farther than, the vertex. It communicates with the facial nerve.

Supra-trochlear, 9.—Also a branch of the frontal. It leaves

the orbit at the inner angle, and running upwards internal to the supra-orbital supplies the skin of this region.

Some twigs of both these nerves, as of the other facial branches of the fifth, are lost in the muscles, which they no doubt supply with common sensation. The supra-orbital is the branch of the fifth which is most commonly affected with neuralgia; and it may be mentioned that the three branches which are most liable to be affected pass through bony foramina, which lie in one vertical line, and that they are arranged in the same order as the divisions of the nerve from which they rise. They are the supra-orbital, the infra-orbital, and the inferior dental. The surgeon should remember the position of the supra-orbital nerve in connexion with wounds of the forehead. Cases are on record in which such an injury to the nerve has been followed by amaurosis, which is supposed to be the result of an interference with the nutrition of the eye, depending upon the communication between the fifth nerve and the ciliary ganglion. The supra-orbital nerve is that which is most commonly the seat of a curious disease, "morphœa," characterised by local anæsthesia and the development of a patch of white cicatricial tissue, over which there is alopecia.

FIG. 2.

This dissection was made from the same subject as Fig. 1, in the following manner :—

The tendon of the occipito-frontalis and the anterior of the belly of the muscle were removed; the posterior belly was turned back. The ear with its muscles and the temporal fascia were then taken away, with all the vessels and nerves lying upon them.

Next the platysma was completely removed, and the parts beneath it cleaned. Parts of the orbicularis palpebrarum, levator labii superioris and levator labii superioris, were cut away to show the branches of the infra-orbital nerve, and the

depressor anguli oris was cut through and turned aside to show the inferior dental nerve.

The parotid gland was taken away whilst the structures contained in it were cleaned.

Lastly, the zygoma with the temporal fascia and part of the masseter and the zygomatic muscles were removed.

By comparing the two figures, the reader will see what structures were exposed at each of these steps of the dissection.

Some surprise may be felt at the shape of the coronoid process of the inferior maxilla, unless it be remembered that the tendon of the temporal muscle is attached to a small part of the external surface, so that the true apex is not seen. The sigmoid notch in the undissected subject is a very small space, as it is much constricted by the wide tendon of the temporal muscle; the curved posterior border of this muscle converts it into a foramen of irregularly oval shape, through which would be seen, if the dissection were carried deeper, part of the insertion of the external pterygoid muscle.

The *pericranium* is the periosteum of the skull; it is very closely adherent to the sutures where minute vessels are transmitted from the inner to the outer aspect of the skull; elsewhere the union is not very close. It is beneath the pericranium that the cephal-hæmatoma of newly-born infants occurs, which, owing to the last-mentioned fact, is usually bounded by the sutures. It may thus be distinguished from extravasations occurring external to the pericranium, which extend to an indefinite distance in the loose cellular tissue separating it from the epicranial aponeurosis. The pericranium is more plentifully supplied with nerves than other periosteal, an interesting fact in connexion with nodes and periostitis in this region.

The *temporal fascia*, ‡, is a firm fibrous membrane consisting of two layers, which, however, are only separate at the lower part. It is firmly attached along the temporal ridge, and also by its two layers to the inner and outer aspect of the zygoma for its whole length. Between these is contained

some loose fat, in which are found the temporal branch of the temporo-malar nerve and the middle temporal and lachrymal arteries. The deeper layer is the thinner; pus may collect either between the two layers or beneath the fascia, in either case an early incision is called for to prevent burrowing from taking place downwards into the pterygo-maxillary region.

External lateral ligament of jaw, †.—The fibres are directed backwards and downwards from the root of the zygoma towards the posterior aspect of the neck of the condyle of the jaw.

Submaxillary gland, †.—(*Vide* p. 35.)

MUSCLES.

All those of the face have been sufficiently described under Fig 1, except the following:—

Buccinator, I.—This arises from the alveolar borders of the upper and lower jaws opposite the molar teeth, and between the two jaws from the pterygo-maxillary ligament. The fibres decussate at the angle of the mouth, but above and below this they pass directly inwards and blend with the other muscles in the lips. The buccinator is pierced by Stenson's duct. In relation with its inner surface is the mucous membrane of the mouth. Its action is to regulate the expulsion of air when the cheeks are distended, and keep the food within the teeth during mastication.

Masseter, L.—The objects seen on removing the masseter are shown in this drawing—viz., the ramus and angle of the jaw, and part of the buccinator with its vessels and nerves.

Temporal, K, if well developed, the glistening tendon radiates into a number of broad strands, which occupy a large proportion of the external surface, and give place to still broader bands of muscular fibre externally. The anterior margin is perpendicular, the posterior almost horizontal. In contact with its deep surface are parts of the frontal, temporal, parietal, sphenoid, and malar bones, the deep temporal vessels and nerves, part of the external pterygoid muscle, and the nerves and vessels to the

masseter and buccinator. It is inserted principally on to the inner surface of the coronoid process, reaching as far as the commencement of the alveolar border. Some fibres are attached to the anterior border of the coronoid process and the external surface of its apex. Its principal action is to raise the jaw; it alone amongst the elevators is also a retractor. A good deal of fat covers its lower part, and it is the wasting of this and the fat between the layers of the muscle which cause the marked hollow above the zygoma during emaciation.

The muscles which have been uncovered by the removal of the platysma are only partially seen; no description of them will be given for the present.

VESSELS.

External carotid, a.—The end of this vessel is shown opposite the neck of the condyle of the jaw. The origin of the internal maxillary which indicates the termination of the vessel is here covered by the vein; it will be shown in Plate 8, Fig. 1. This part of the vessel is imbedded in the parotid gland.

Posterior auricular, b, usually leaves the vessel about the upper border of the digastric—i.e., rather lower than in this case. It runs upwards over the styloid process, and then backwards beneath the ear. Its auricular and occipital branches have been seen (Fig. 1); its small stylo-mastoid branch is figured in Plate 8, Fig. 2, running up the foramen of that name with the facial nerve (Plate 8, Fig. 2, 22).

The commencement of the *temporal artery, c,* is here shown. The middle temporal is a branch in this part of its course.

Appearing at the posterior border of the tendon of the temporal muscle is the branch to the *masseter, d,* and at the anterior are the *buccal, h,* and *posterior dental, e,* both branches of the *internal maxillary.*

The *facial, j,* is now seen in the whole of its course on the face, and one branch below the jaw, the submental *g* (*vide*

Plate 3, Fig. 2). The artery has been slightly moved so as to occupy an almost natural position, but the arrangement of its branches is somewhat irregular. The *inferior labial*, *k*, runs under the platysma, and supplies the lower part of the lower lip and chin, and anastomoses with the inferior dental, *f*. The *superior*, *m*, and *inferior coronary*, *l*, here run together, which is a common arrangement; the former is the larger of the two, and gives off the small *artery of the septum*, *n*. This branch here supplies also the *lateral nasal*, *o*, which generally leaves the trunk itself.

The *angular artery*, *p*, is the termination of the facial; it reaches the inner canthus of the eye, and anastomoses with branches of the infra-orbital, *g*, and ophthalmic.

Some branches of the facial join the transverse facial from the temporal and the buccal from the internal maxillary. The artery may always be found at the anterior margin of the masseter muscle, which can be felt in the stoutest subject. Its course is very tortuous, but may be roughly said to be to the angle of the mouth, angle of the nose, and inner angle of the eye. Its tortuosity is no doubt to allow the free movement of the structures of the face. It is often necessary to divide it in operations about the jaws. Its numerous branches give rise to great hæmorrhage in wounds of the face, but the contraction that takes place is so great, that this usually stops without the application of a ligature.

The end of the *mylo-hyoid branch*, *i*, of the internal maxillary is shown on the muscle of that name.

The other superficial branches shown in this drawing are the *hyoid branch of the lingual*, *r*, and often a similar branch below the hyoid bone from the superior thyroid; these two small arteries mutually replace one another, and vary much in size (*vide* p. 44).

VEINS.

The arrangement of the veins in this subject was not the normal one. No external jugular was found, but a large

trunk passed down with the external carotid artery, *a*, to join the common facial vein at the angle of the jaw (*cf.* p. 44). This trunk is sometimes called the *temporo-maxillary*. When such a disposition exists, the blood from the temporal and pterygoid regions finds its way altogether into the internal jugular.

NERVES.

The termination of the *infra-orbital branch*, 9, of the superior maxillary, dividing into *palpebral*, *nasal*, and *labial* filaments, has been shown by cutting through the orbicularis palpebrarum and the levator proprius. Two branches of the *facial*, 1, 1, are shown joining it.

The *labial branch*, 10, of the inferior dental nerve, appears through the mental foramen, and is joined by another branch of the facial.

Below the jaw is the small *nerve to the mylo-hyoid*, 11, also from the inferior dental.

In front of the coronoid process are seen the *posterior dental*, 6, from the superior maxillary, and the *buccal*, 8, from the inferior maxillary; and appearing over the sigmoid notch is the *nerve to the masseter*, 7, from the inferior maxillary, which has been cut.

The trunk of the *facial*, 1, and the cervico-facial branches are now fully exposed; the latter are named respectively *buccal*, *supra-maxillary*, and *infra-maxillary*. They join the temporo-facial division, the buccal and inferior dental of the fifth, and the superficial cervical, 4, from the cervical plexus.

PLATE 8.

FIG. 1.

THIS drawing shows all the deep branches of the external carotid. The dissection was made from that shown in Plate 7, Fig. 1, by turning back the sterno-mastoid and detaching it from the mastoid process. The splenius capitis which then appeared was treated in the same way, showing the whole of the posterior belly of the digastric and the trachelo-mastoid, as well as the transverse process of the atlas and the muscles attached to it.

The temporal muscle and half the lower jaw were then taken away, separating the latter from the pterygoid, mylo-hyoid, and digastric muscles, and dividing at the same time the inferior dental vessels and nerve. The digastric and mylo-hyoid muscles, and the superficial part of the submaxillary gland, were removed, as well as all the muscles about the mouth, except the upper attachment of the buccinator; and the mucous membrane was taken from the sublingual gland and the side of the tongue. The pterygoid muscles were sufficiently shortened to expose the branches of the internal maxillary artery and the inferior maxillary nerve; and, lastly, the trachelo-mastoid muscle was detached from the mastoid process, and the latter sawn off; and a portion of the skull was taken away in order to expose the main branches of the middle meningeal artery.

The deep part of the *submaxillary gland*, +, is shown resting on the hyo-glossus muscle, and passing forward from it is *Wharton's duct*, * (p. 36). The relation to this of the submaxillary ganglion, 14, and the manner in which the gustatory nerve, 4, winds round it, should be observed. The duct runs forward, in contact with the sublingual gland, to the *frænum linguae*.

The *sublingual gland*, $\times$, lies in a hollow on the inner surface of the lower jaw; it is in contact above with the mucous membrane of the mouth, and internally with the genio-hyo-glossus and hyo-glossus, and below with the mylo-hyoid. It is more than an inch and a half long. The gustatory nerve winds round its posterior extremity, and the end of the hypoglossal nerve and the lingual artery are in contact with its internal surface; its ducts (ducts of Rivini) open partly into Wharton's duct, partly by separate openings at the side of the frænum linguæ.

MUSCLES.

For a description of the muscles in the submaxillary region, *see* p. 40; for those in the suboccipital triangle, *see* p. 60; and for those in the pterygoid region, *see* Plate 9.

ARTERIES.

External carotid, *c*, beginning at the level of the upper border of the thyroid cartilage, where the common carotid bifurcates; the vessel extends as far as the neck of the condyle of the lower jaw, where it ends by dividing into the temporal and internal maxillary arteries. It is covered only by the sterno-mastoid as far as the level of the lower border of the digastric muscle, but beyond this it is covered by this muscle and the stylo-hyoid, and enters the substance of the parotid gland. It rests from below upwards upon the internal carotid artery, *b*, and the styloid process and the stylo-pharyngeus muscle. It is usually unaccompanied by a vein, but, as in Plate 7, Fig. 2, a large temporo-maxillary trunk is occasionally found. The hypoglossal, 11, and facial, 10, nerves cross over it; and the glosso-pharyngeal, 15, superior laryngeal, and external laryngeal pass beneath it.

The posterior branches are two, and often three.

1. *Occipital*, *i*, arising opposite the facial, at or below the level of the lower border of the digastric; it ascends under

cover of that muscle and the sterno-mastoid to the level of the transverse process of the first vertebra; it passes over this, lying in a groove beneath the mastoid process, and runs backwards beneath the splenius and sometimes the trachelo-mastoid, while resting on the superior oblique, O, and complexus muscle, N. Near the middle line its course becomes again vertical, and it reaches the surface by perforating the trapezius, and takes the course in the scalp described at p. 66. It crosses the internal carotid artery, internal jugular vein, and spinal accessory nerve. At its origin the hypoglossal nerve turns round it. In the neck it gives off a branch to the *sterno-mastoid*, *j*, round which the hypoglossal nerve usually winds; and another, the *princeps cervicis*, *k*, which descends beneath the complexus to anastomose with the profunda cervicis from the superior intercostal, p. 20. There are besides small branches to the diploe of the skull, and to the muscles between which it passes, and to the back of the ear; and a minute meningeal branch which ascends with the internal jugular vein to the jugular foramen.

2. *Posterior auricular*, *l* (see p. 73).

3. *Sterno-mastoid* (*vide* p. 9).—This branch is not constant, and was not present here.

Two are directed upwards.

1. *Temporal*, *m* (*vide* p. 66).

2. *Ascending pharyngeal*, Fig. 2, *l*, rising at or near the commencement of the external carotid from its internal surface. It ascends first between the external and internal carotids, and then to the inner aspect of the latter, between it and the pharynx, to the level of the upper border of the superior constrictor. There it sends two or three branches inwards to supply the soft palate and Eustachian tube, and one or more small meningeal branches upwards through the foramen lacerum medium. As it ascends it gives off small branches to supply the tonsil and the muscles of the pharynx, as well as the rectus capitis anticus major, the stylo-glossus, the first

cervical ganglion, and the cervical nerves. The vessel varies much in size and point of origin. It may leave one of the other branches of the external carotid. It anastomoses below with the superior thyroid.

The anterior branches are four.

1. *Superior thyroid* (see p. 43).

2. *Lingual, e* (comp. Plate 4, Fig. 1), arising just above the level of the hyoid bone. It is directed forwards beneath the hyo-glossus muscle and the sublingual gland, on the surface of the middle constrictor and genio-hyo-glossus muscles to the tip of the tongue. The hypoglossal nerve crosses over a loop in it at the level of the posterior border of the hyo-glossus muscle. A branch of the gustatory nerve is in close contact with its termination. The branches are better seen in Plate 4. They are *hyoid, f*, of variable size, anastomosing with a similar branch from the superior thyroid; the *dorsal artery* of the tongue, arising under the hyo-glossus muscle, and often consisting of several small twigs; the *sublingual* branch or branches to the gland of that name; and the *ranine*, which is really the termination of the vessel itself, running on the genio-hyo-glossus to the tip.

It is sometimes necessary to tie the lingual artery on account of uncontrollable bleeding from the tongue. This is done by a curved incision of variable length, according to the taste of the operator, the convexity of which is downwards, and the middle point of which is opposite the great cornu of the hyoid bone. After dividing the superficial structures and platysma, the submaxillary gland is usually seen, and may require hooking up. Immediately above the tendon of the digastric, which now appears, are seen the edge of the mylo-hyoid muscle and hypoglossal nerve resting on the hyo-glossus; and on cutting through the fibres of this muscle, immediately below the nerve, the artery will be reached. The terminal branches of the lingual artery in the tongue have scarcely any anastomoses with the corresponding branches of the opposite

side, and hence an incision in the middle line of the tongue is followed by insignificant hæmorrhage; the hyoid branch, however, forms an arch across the middle line with the corresponding artery, and anastomoses are said to occur between the two dorsal arteries at the foramen cæcum and the two ranine arteries round the frænum linguæ.

The *facial*, *h*, has been shown in Plates 4 and 7. The branches below the jaw are seen in the latter. Arising opposite the occipital from the anterior part of the carotid, it passes upwards and forwards to the lower margin of the lower jaw, at the anterior border of the masseter. In this part of its course it is imbedded in a groove at the posterior and upper parts of the submaxillary gland, and supplies the following branches:—*Submaxillary*, Plate 3, Fig. 2, *c*, several small branches for the supply of the gland; *submental*, Plate 3, Fig. 2, *b*, a large branch which runs forward on the mylohyoid muscle to anastomose with the corresponding artery of the opposite side, and supplies muscular and cutaneous offsets; *tonsillar*, Plate 4, Fig. 1, *m*, ascending between the internal pterygoid and stylo-glossus muscles to supply the tonsil; and *palatine*, Fig. 2, *e*, which ascends between the stylo-glossus and stylo-pharyngeus to reach the upper border of the superior constrictor, and anastomose with the other arteries supplying the soft palate, the Eustachian tube, and the tonsil.

For the description of the facial part, *see* p. 74.

4. *Internal maxillary*, *n*.*—One of the terminal branches of the external carotid, beginning opposite the neck of the condyle of the lower jaw, runs inwards and forwards to the sphenomaxillary fossa, where it divides into its terminal branches. In this course it passes first between the jaw and the internal lateral ligament, then either superficial to or beneath the external pterygoid muscle; in the former case it reaches the

* The relations of this artery are better shown in the dissection of the ptergo maxillary region, Plate 9.

spheno-maxillary fossa by passing between the two heads of origin of the muscle. It is divided, for the sake of description, into three parts. The first behind the neck of the jaw gives off the following branches:—*middle meningeal, p*; this ascends between the two cords which form the auriculo-temporal nerve, 2, to the foramen spinosum, through which it enters the skull and divides into numerous branches for the supply of the dura mater; the two principal ones are shown in the drawing; * *small middle meningeal, q*, arising either separately or from the last, enters the skull through the foramen ovale; *inferior dental, o*, passes downwards to the inferior dental foramen, which it enters after giving off the small *mylo-hyoid* branch (Plate 7, Fig. 2, *i*), runs forward in the substance of the jaw, supplying branches to the molar bicuspid and canine teeth, and ends by dividing into an *incisor* branch for the supply of the incisor teeth and the *mental branch* (Plate 7, Fig. 2, *f*), which passes through the foramen of the same name to supply muscular branches and anastomose with the facial. The second part intervenes between the jaw and the spheno-maxillary fossa. From it are given off muscular branches to the *masseter, t*, *external pterygoid, u*, *internal pterygoid*, and two *deep temporal, r* and *s*, which ascend beneath the temporal muscle which they supply, anastomosing with the other temporal arteries and the lachrymal. Two branches only of the third part are visible in this Plate. The *posterior dental, v* (Fig. 2, *i*), enters a small foramen in the superior maxilla, and, passing downwards, supplies the molar and bicuspid teeth. The *infra-orbital* (Fig. 2, *j*), lying in the infra-orbital groove and canal, supplies small twigs to the orbit and an *anterior dental* branch, which, running down in

* The surface marking for the anterior branch is a line through points at equal distances behind the external angular process and above the zygoma—i.e., one and a quarter, one and a half, or two inches (Thane). The last is the most favourable point to choose for trephining, as there the vessel lies in a comparatively shallow groove in the parietal bone. Below this it occupies a deep groove, often a canal above the great wing of the sphenoid, and thus, if trephining be practised here, a thick piece of bone must be removed, and the vessel must be almost certainly torn across in the process.

the anterior wall of the autrum of Highmore, supplies the incisor teeth of the upper jaw ; it ends by appearing on the face, where it anastomoses with the facial. The other branches, *spheno-palatine*, *descending palatine*, *pterygo-palatine*, and *vidian*, will be shown in dissections of the nose.

The surgical interest of the artery arises from its proximity to the neck of the lower jaw. It is liable to be wounded in excision of the jaw, unless the knife be used sparingly and close to the bone during the later steps of the operation ; hæmorrhage under such circumstances is often free, and difficult to arrest.

NERVES.

**Inferior maxillary*, 1.—Compare Fig. 2. The lowest branch of the fifth nerve, and receiving the whole of its motor root, passes as a single trunk through the foramen ovale (Fig. 2, 15), giving off as it does so the small nerve (Fig. 2, 17) to the *internal pterygoid*. It then divides into a small motor part (Fig. 2, 16), which divides into nerves for the supply of the remaining muscles of mastication—viz., two *deep temporal*, 5 and 6 ; *buccal*, 7 ; *masseteric*, 8 ; and one for the *external pterygoid*, which comes off in connexion with one of the other branches. The much larger sensory division of the nerve breaks up into the following three large trunks :—

The *auriculo-temporal*, 2 (Fig. 2, 20), arises by two roots, between which passes the middle meningeal artery, and takes a course almost directly backwards behind the temporo-maxillary articulation ; it then turns vertically upwards in company with the superficial temporal artery, *m*. It gives branches to the otic ganglion, to the facial nerve, to the parotid gland, the articulation of the jaw, the external auditory meatus, the pinna of the ear, and the skin of the temple. The *inferior dental*, 3, descends almost vertically to the inferior dental foramen ; its course and branches correspond with those of the artery of the same name, p. 81.

* The relations of this nerve are better shown in the dissection of the pterygo-maxillary region, Plate 9.

Division of the inferior dental nerve has been practised for the relief of neuralgia; this may be done from inside the mouth as the nerve is passing into its foramen, or by extracting a tooth and passing a chisel into the empty socket, or by trephining the lower jaw. It must be remembered that the canal only approaches the external surface of the bone at its termination. Fracture of the lower jaw may cause injury of this nerve.

The *gustatory*, 4, situated a little in front of the inferior dental, also passes almost vertically downwards till it reaches the posterior part of the sublingual gland. It makes a turn round this structure, which includes Wharton's duct, and then passes obliquely upwards and forwards towards the tip of the tongue. Near its commencement it is joined by the small *chorda tympani* (Fig. 2, 21) from the facial, which emerges through the Glaserian fissure. The fibres of this nerve accompany those of the gustatory as far as the level of the sublingual gland, where part leave it to pass to the *submaxillary ganglion*, 14; the remainder pass on with the nerve to the tongue. The gustatory is joined by branches from the hypoglossal on the surface of the hyo-glossus, and it supplies the mucous membrane of the sides and anterior part of the tongue.

The *submaxillary ganglion*, 14, is situated close to the deep part of the submaxillary gland, +. It receives motor fibres from the chorda tympani, sensory from the gustatory, and sympathetic from the plexus upon the facial artery. Its branches of distribution pass to the submaxillary gland, Wharton's duct, and the mucous membrane of the mouth.

The *hypoglossal nerve*, 11, leaving the skull through the anterior condyloid foramen, passes between the internal carotid artery and the internal jugular vein, in close contact with the ganglion of the trunk of the vagus. Its course is then downwards till it reaches the level of the facial artery, where it crosses over the carotid, hooking round the occipital artery, as well as the sterno-mastoid branches of the occipital and

external carotid, if either or both are present. It then passes downwards to the level of the hyoid bone, crossing over the loop of the lingual artery, and lying on the hyo-glossus muscle, at the anterior border of which it enters the genio-hyo-glossus and breaks up into branches for the supply of the muscles of the tongue. It is connected near its exit from the skull with the pneumogastric and the sympathetic, and the loop between the first two cervical nerves, and at the side of the tongue with the gustatory nerve. It gives a branch, the *descendens noni*, 12 (*see* page 11), as it crosses the carotid for the supply of the depressors of the hyoid bone, and a special branch a little later to the *thyro-hyoid* muscle, 13.

FIG. 2.

This is intended to show the internal carotid artery in the whole of its course, and its relation to the cranial nerves.

It was made from the last dissection, by removing the external carotid artery and its branches, the pterygoid muscles and the branches of the lowest division of the fifth nerve, with the sublingual gland. The styloid process which was then exposed was taken away with the stylo-glossus and stylo-pharyngeus; the greater part of the hyo-glossus was also removed. The upper part of the sterno-mastoid was cut away, and the cervical nerves lying beneath it were cleaned.

A vertical saw-cut was made in the skull, behind the mastoid process, into the stylo-mastoid foramen, and another through the roof and floor of the orbit, so as just to remove the outer wall and pass back to the sphenoidal fissure; these were made to communicate by a cut with the chisel, applied inside the skull, and carried through the foramina rotundum, ovale, and spinosum. By a little careful chiselling the inner wall of the tympanum was exposed, and the aqueduct of Fallopius as far back as the position of the intumescencia gangliiformis. The

dura mater was cleaned away from the first seven cranial nerves and the carotid artery; and, lastly, the outer wall of the antrum was removed in order to expose the infra-orbital and posterior dental vessels and nerves.

It will be noticed that although the outer wall of the orbit has been taken away, no dissection of the structures contained has been made; all that is shown is the periosteum, ¶, of the orbit, which conceals its contents. In the same way the removal of the wall of the antrum does not open up its cavity, but merely the outer surface of the mucous membrane, ‡, which lines it.

MUSCLES.

No new muscles are here exposed except the *stylo-pharyngeus*, E, which has been almost completely removed, the *superior constrictor*, B, and the *tensor palati*, C. The relation of these two muscles should be remembered: the latter is always exposed in the deep dissection of the pterygo-maxillary region—*i.e.*, after removing the internal pterygoid muscle.

ARTERIES.

For the branches of the external carotid, *see* pp. 73–82.

Internal carotid, m, is here exposed as far as the point at which it enters the carotid canal, and in its course after leaving the foramen lacerum medium. Its relations to the deep nerves, and the direction which it takes whilst in the temporal bone, are shown in the accompanying woodcut, in which the vessel is pulled slightly forward.

Beginning at the bifurcation of the common carotid—*i.e.*, at the level of upper border of the thyroid cartilage—it ascends almost vertically to the carotid canal, making, however, two curves, the first with the convexity backwards, the other in the opposite direction. Its line on the surface of the body corresponds almost exactly to that of the external carotid; it lies at first behind that vessel, but soon passes inside it.

It is covered at first by the sterno-mastoid muscle, and crossed by the hypoglossal nerve, the digastric muscle, and occipital and posterior auricular arteries. It is in contact besides, on its outer surface, with the external carotid, the parotid gland, the styloid process and stylo-pharyngeus muscle, the glosso-pharyngeal nerve and some of its branches, the pharyngeal branch of the vagus, and some branches of the sympathetic.



Deep Nerves and Vessels at Root of Neck.

- A, Rectus capitis lateralis. B, Obliquus superior. C, Obliquus inferior. D, Splenius Capitis. E, Levator Anguli Scapulae. F, Scalenus medius. G, G, Anterior inter-transverse muscles. H, Tensor Tympani. K, Stapedius.
 a, Common carotid. b, Internal carotid. c, External carotid.
 d, Ascending pharyngeal. e, Occipital.
 a, Internal jugular vein.
 1, Glosso-pharyngeal. 2, Pneumo-gastric. 3, Spinal accessory.
 4, Hypoglossal. 5, First cervical. 6, Second cervical. 7, 7, 7, Sympathetic. 8, Facial. 9, Arnold's nerve. 10, Tympanic plexus.

It rests upon the rectus capitis anticus major, the superior laryngeal, and external laryngeal nerves, and the superior ganglion of the sympathetic with some of its branches. To its inner side are the superior and middle constrictors of the pharynx, and the ascending pharyngeal artery; to its outer side and behind is the internal jugular vein, with the vagus, glosso-pharyngeal, hypoglossal, and spinal accessory nerves.

After entering the carotid canal the vessel at first ascends, then turns forwards and inwards, and, when it reaches the cartilage of the foramen lacerum medium, ascends vertically to the anterior clinoid process. In this canal it is close to the front of the tympanum, and is surrounded by branches of the sympathetic. After leaving the foramen lacerum medium it makes a sigmoid curve, resting by its inner surface upon the side of the sphenoid bone, covered externally by the lining membrane of the cavernous sinus, and surrounded by branches of the sympathetic (carotid and cavernous plexuses). It is crossed here by the sixth nerve. After its last turn backwards at the inner side of the anterior clinoid process, it pierces the dura mater and divides into three trunks, the *middle* and *anterior cerebral*, and the *posterior communicating*, which enter into the formation of the *circle of Willis*. Here it lies outside the second nerve.

No branches are given off in the neck. In the temporal bone it gives off a minute *branch to the tympanum*; in the cavernous sinus it gives off small branches to supply the dura mater, *arteriæ receptaculi*; and just before or after piercing the dura mater, the *ophthalmic* artery from its inner side, and then the three branches for the brain mentioned above.

The artery may require ligature in cases when it is impossible to reach the common trunk, also in cases where aneurism or bleeding is known, or suspected, of one of its branches. The operation is almost the same as that for tying the common carotid. The vessel is in very close proximity to the

tonsil, during the removal of which it is possible to wound the vessel if the bistoury be not kept within the line of the teeth; cases of traumatic aneurism following removal of the tonsil have occurred. The free hæmorrhage, however, which not unfrequently follows the operation, generally comes from one of the large vessels by which the gland is supplied. An aneurism may occur on this artery outside the skull, in which case it will project into the pharynx; and the vessel or its branches may be the seats of the different forms of intracranial or orbital aneurism.

VEINS.

The *internal jugular vein*, *a*, is uncovered in the upper part of its course, and a small piece of the wall of the lateral sulcus has been removed, exposing the *lateral sinus*, *β*. The vein has been allowed to collapse in order to show the surrounding structures. Its lower part is shown in Plates 1-4.

In close contact with the internal carotid artery, it covers its external and partly its posterior surface. It is in contact by its anterior surface with the sterno-mastoid below, and the parotid gland and styloid process with the stylo-pharyngeus and stylo-hyoid above, and is crossed by the digastric muscle, the occipital and posterior auricular arteries, and usually by the spinal accessory nerve. It rests upon the rectus capitis major, minor, and lateralis muscles, as well as the vagus and spinal accessory at their egress from the jugular foramen and the upper ganglion of the sympathetic a little lower down. Behind it, and almost overlapping it, is the transverse process of the first vertebra. Between it and the artery pass out the hypoglossal, the glosso-pharyngeal, and the spinal accessory. The lateral sinus ascends slightly before it dilates into the upper bulb of the internal jugular which occupies the jugular fossa. In the fossa the small nerve of Arnold crosses the vein. (*See woodcut*, p. 86.) It receives no tributaries in this part of its course. The jugular vein may be reached by

dissection from the surface throughout its extent without the removal of any portion of bone.

NERVES.

The *second, third, fourth, and fifth* nerves are much better seen in Plate 12, Fig. 4, the second division of the fifth will be alone noticed here.

The *superior maxillary nerve*, 7, leaving the anterior part of the Casserian ganglion and the skull by the foramen rotundum, crosses the upper part of the spheno-maxillary fossa to enter the infra-orbital canal. After passing through this almost horizontally forwards, it emerges on the face through the infra-orbital foramen, where it divides into terminal branches—*palpebral*, 12, *nasal*, 13, and *labial*, 14—which are joined by branches from the facial (*see* Plate 10, Fig. 4). While crossing the spheno-maxillary fossa it gives off descending branches, *spheno-palatine*, to Meckel's ganglion—and the *orbital or temporo-malar nerve*, 8, which divides into two cutaneous branches for the temple and cheek, making their exit through two foramina in the malar bone, and joins the lachrymal. As it enters the infra-orbital canal it gives off the *posterior dental nerves*, 11; these are usually two in number, of which the posterior enters a canal on the outer surface of the superior maxilla, and supplies the lining membrane of the antrum as well as the upper molar teeth, and joins the anterior dental nerve; the anterior branch supplies the gums and buccinator muscle. The *anterior dental*, 10, leaves the nerve near its exit from the infra-orbital canal, and enters a special canal by which it is conducted downwards to supply the bicuspid, canine, and incisor teeth.

The *facial nerve*, 22, is shown in the aqueduct of Fallopius. As it enters this canal there is a swelling known as the *intumescencia gangliiformis*, at which point it is joined by the *petrosal nerves*, the greater and external of which are shown; the *greater*, 24, is the end of the Vidian, and comes through

the foramen lacerum medium from Meckel's ganglion; the *external*, 25,* comes from the sympathetic on the middle meningeal artery. The *small* nerve, which is not shown, is a branch of communication between the facial and the otic ganglion. The position of the otic ganglion is indicated by 17 (the nerve to the internal pterygoid). As the facial descends it gives off a minute *nerve to the stapedius*, and the *chorda tympani*, 21, which, after passing across the membrana tympani between the handle of the malleus and the long process of the incus, emerges through the canal of Huguier, close to the Glaserian fissure, and joins the *gustatory*, 19. It has been uncovered by throwing forwards the *inferior dental*, 18.

The *glosso-pharyngeal*, 26, leaves the jugular foramen a little in front of the other divisions of the eighth nerve. It comes forward between the internal carotid artery and jugular vein, and, after passing over the former, it turns round the stylo-pharyngeus muscle at the level of the angle of the jaw. It then passes beneath the hyo-glossus muscle and divides into two branches (*lingual*), one of which passes to the mucous membrane at the back of the tongue; the other enters the muscular fibres, and supplies the mucous membrane of its sides. Some twigs go to the circumvallate papillæ.

There are two ganglia on the nerve as it leaves the skull; the upper, very small, and called *jugular*, is in the upper part of the foramen; the lower, *petrous*, is shown in the woodcut, p. 86, and is situated in a small fossa on the petrous part of the temporal bone. It gives off the small *tympanic* branch (*nerve of Jacobson*) to the *tympanic plexus*, 27, and also communicating branches to Arnold's nerve, the upper ganglion of the vagus, and the upper ganglion of the sympathetic. As the nerve crosses the artery it supplies a *carotid* branch which lies on the vessel, and joins the pharyngeal plexus; and,

* This has by an oversight been represented very much too large in the drawing. It is a very minute nerve indeed.

afterwards, *muscular* branches to the upper and middle constrictors and the stylo-pharyngeus, *pharyngeal* branches to the pharyngeal plexus, and *tonsillitic* to the circulus tonsillaris.

The *spinal accessory*, 35, has been seen in several other dissections (Plate 1, Fig. 2 ; Plate 5, Fig. 1, &c.). It consists of two parts, which leave the skull through the jugular foramen, in close contact with the ganglion of the root of the vagus. The accessory portion then unites with the trunk of the vagus, while the spinal part turns backwards usually superficial to, but sometimes beneath, the internal jugular vein. It then enters the substance of the sterno-mastoid muscle, as described at p. 4, where it is joined by branches from the second cervical nerve, and supplies branches to the muscle. After emerging from its posterior border, it crosses the posterior triangle of the neck. It then passes beneath the trapezius, which it supplies, running for a considerable distance vertically downwards in company with branches of the superficial cervical artery, and joined by branches of the cervical plexus.*

* The branches of the cervical nerves (36 and 37) are described at page 10.

PLATE 9.

THIS plate is intended as explanatory of some of the special parts shown in the last two plates. Figs. 1 and 2 are the ordinary dissections to expose the pterygo-maxillary region. Fig. 3 shows the common carotid artery at the seat chosen for ligature.

FIG. 1.

To make the dissection, a horizontal incision was made half an inch above the upper border of the zygoma for its whole length, a second along the lower margin of the inferior maxilla, from just behind the angle to an inch in front of the anterior edge of the masseter, and the extremities of these were joined by vertical cuts. The superficial structures and deep fascia (Plate 7, Fig. 1) were removed, exposing the masseter and the parotid gland. The parotid, $\times$, was then partly cut away, partly turned back, and the masseter, B, was separated from the zygoma and turned downwards and backwards. The zygoma was then divided at each extremity, * and ‡, after cutting through the layers of the temporal fascia, ¶, and taken away. In this way the coronoid process, with the insertion of the temporal muscle, the buccal and masseteric vessels and nerves were exposed. The coronoid process was then sawn off and the temporal muscle turned up. Afterwards a square piece of the jaw was removed by cutting vertically downwards, immediately in front of the condyle, for a distance equal to half the depth of the ramus, joining it by a horizontal cut forwards at the same level—i.e., at that of the inferior dental canal. The external lateral ligament of the jaw was removed, so as to show the inter-articular fibro-cartilage, and a quantity of loose fat taken away from the other structures exposed.

MUSCLES.

The *external pterygoid*, C, arises from the outer surface of the external pterygoid plate, and from the great wing of the sphenoid below the crest. Its fibres converge as they pass backwards, and are inserted into the front of the neck of the condyle of the lower jaw, and into the inter-articular fibro-cartilage. The internal maxillary artery lies sometimes superficial to the muscle, sometimes beneath it. In either case it passes between the two heads of origin to enter the spheno-maxillary fossa. Superficial to the external pterygoid are the temporal muscle and part of the lower jaw; it rests upon the internal pterygoid muscle, the internal lateral ligament of the jaw, and some of the branches of the inferior maxillary nerve; of these the gustatory and inferior dental make their appearance at its lower border, the masseteric and deep temporal at its upper border, while the buccal passes out between the heads. The action of the muscle is to draw the condyle of the jaw of its own side forwards.

The *internal pterygoid*, D, Fig. 2, B, arises from the inner surface of the external pterygoid plate, and from the tuberosities of the superior maxilla and palate bones. Its fibres pass downwards and backwards, and are inserted on the inner surface of the ramus and angle of the jaw, reaching up as far as the inferior dental foramen.

Superficial to the muscle are the internal lateral ligament of the jaw, the external pterygoid muscle, and the inferior dental and gustatory nerves. It rests upon the tensor palati, the superior constrictor of the pharynx, the stylo-glossus muscle, as well as branches of artery ascending to the palate and tonsil. The action of the muscle is the same as that of the masseter—viz., to draw the jaw upwards.

VESSELS AND NERVES.

The description of the internal maxillary artery will be found at p. 80; that of the inferior maxillary nerve at p. 82.

The veins, of which a few only are figured, form a considerable plexus in the interval between the temporal and pterygoid muscles. This plexus receives branches corresponding with those of the internal maxillary artery, and supplies behind the two veins that accompany this artery. In front it communicates through the spheno-maxillary fissure with the ophthalmic vein, and by a large branch (*anterior internal maxillary*), γ , which crosses the buccinator muscle, it joins the facial. (See page 44.)

FIG. 2

Shows the deep dissection of the pterygo-maxillary region. It was made from the last by removing completely the external pterygoid muscle, and that part of the inferior maxilla which was left above the level of the inferior dental canal. The inter-articular fibro-cartilage was taken away, the temporal muscle turned up a little further, and the parts thus exposed were cleaned. Lastly, the insertion of the masseter was taken away, and the outer compact layer of the lower jaw was chiselled away so as to expose the inferior dental vessels and nerve.

Almost everything now exposed has been described in connexion with Fig. 1, or else at pages 80 and 82. It may be well to point out how the auriculo-temporal breaks up into a brush of nerves under the neck of the jaw, and also that the branch to the external pterygoid comes off in common with the nerve to the buccinator, that this nerve is united with the anterior temporal, and that the buccal nerve itself sends a twig to the front of the temporal muscle.

The *internal lateral ligament of the jaw*, $\dagger$, is a broad band of fascia passing downwards and forwards from the spinous process of the sphenoid to the margin of the inferior dental canal. It can scarcely be called a true ligament of the articulation, as part of the external pterygoid muscle, the internal maxillary vessels, the auriculo-temporal nerve, and the inferior dental vessels and nerve intervene between the two.

FIG. 3

Shows the dissection to expose the common carotid artery at the seat selected by preference for ligature—i.e., opposite the cricoid cartilage. For its description all that will be required is an account of the steps by which the structures were exposed.

An incision was made along the sterno-mastoid muscle from the sterno-clavicular articulation to the level of the upper border of the thyroid cartilage. From the ends of this horizontal incisions were carried for about two and a half inches forwards above and backwards below, and the triangular flaps were reflected. The platysma and superficial fat were then taken away, leaving a branch of the superficial cervical nerve, 4. The deep fascia was then similarly removed, showing the edge of the sterno-mastoid with the structures which are seen along the anterior border (Plate 3, Fig. 2). Amongst these are particularly to be noticed a tributary of the *anterior jugular vein*, *ε*, and the *sterno-mastoid branch of the superior thyroid artery*, *c*.

The sterno-mastoid was then turned backwards, exposing the sheath of the vessels with the *descendens noni nerve* lying on it (in this case it was within the sheath between the artery and vein, 1). In front of the sheath are the *sterno-thyroid*, *D*, and *inferior constrictor muscles*, *F*, and the *superior thyroid artery*, *b*, and crossing it the *omo-hyoid*, *C*. The last step was to remove the sheath, which disclosed the artery and the vein, the latter being joined by the middle thyroid vein; and in this case the *descendens noni*, 1, being joined by the trunk formed by the *communicantes noni*, 2, was now seen for the first time. For the description of the method of ligature, see page 43.

PLATE 10

ILLUSTRATES the anatomy of the nose and the parts in relation with it.

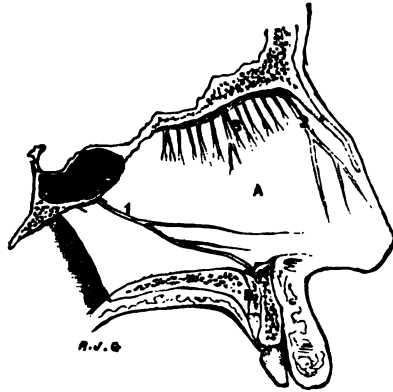
FIGS. 1 AND 2

Show what is seen of the nose if a vertical and longitudinal section of the skull be made slightly to the left of the middle line. In Fig. 2, the mucous membrane was taken from the Eustachian tube, the upper part of the pharynx, the back of the soft palate, and the back of the nasal fossa. The uvula was pulled forward in order to expose the muscles more fully.

In Fig. 1 is seen the *septum nasi*, *a*, covered with mucous membrane, through which are seen the vessels by which it is supplied—viz., the *artery of the septum*, or *naso-palatine*, *a*, from the internal maxillary, and the *posterior ethmoidal*, *b*, and *anterior ethmoidal*, *c*, from the ophthalmic. The nerves may be shown by removing the osseous and cartilaginous portions of the septum and looking at the mucous membrane from the inner side (*see woodcut*). At the upper part are then seen branches of the olfactory, in front a branch of the nasal, and running obliquely downwards and forwards to the anterior palatine canal, the naso-palatine from the superior maxillary. The mucous membrane of the septum is thick and soft, yellowish above where it forms part of the olfactory region proper, and reddish below where it enters into the respiratory tract. The firm structures in the septum are shown in the woodcut, p. 104; they may be exposed by removing the mucous membrane from them. Behind is the vertical plate of the ethmoid and the vomer, and in front are the cartilage of the septum and the inner part of the cartilage of the aperture (*see page 103*).

Behind the septum, at the upper part of the drawing, is

seen the *sphenoidal septum*, *ι*, and below this the dome-like top of the pharynx and the tip of the mucous membrane covering the *inferior turbinate bone*, *κ*. Immediately behind



- | | |
|--|--|
| <p>A, Mucous membrane of left side of septum.</p> <p>B, Anterior palatine canal.</p> | <p>1, Naso-palatine nerve.</p> <p>2, Nasal nerve.</p> <p>3, Olfactory nerve.</p> |
|--|--|

and below this is the opening of the *Eustachian tube*, *λ*, and in the mucous membrane of this part of the pharynx are many deepish pits; one of which, at the posterior part, in most cases leads to a small cavity, the so-called *bursa pharyngis* of Mayer. This is supposed to represent the remains of the diverticulum from the mouth from which the development of the pituitary body takes place. (Luschka, "Der Schlundkopf des Menschen," p. 26.) Luschka has also pointed out that the mucous membrane of this part is provided with masses of adenoid tissue, similar in structure to the tonsils, and he suggests a possible relation between this and the tumours originating in this region. The size and shape of the portion of the cartilage of the tube which projects into the pharynx is shown in Fig. 2.

In Fig. 2 are shown the turbinate bones covered by mucous membrane, and the meatuses formed by them; their appearance after the removal of the mucous membrane is shown in

Plate 11, Fig. 2. The *upper turbinate bone*, θ , overhangs the upper meatus, above it the sphenoidal sinus opens on to the roof of the nasal fossa; the reference is placed in front of a small fourth meatus which is very commonly found communicating with some of the posterior ethmoidal cells. Into the superior meatus open the posterior ethmoidal cells. The *middle turbinate bone*, ι , overhangs the middle meatus, into which opens the antrum of Highmore, the entrance to which is indicated by the reference, κ , and also the infundibulum which leads to the anterior ethmoidal cells and the frontal sinus. The *inferior turbinate bone*, κ , overhangs the inferior meatus into which at the fore-part opens the ductus ad nasum, Plate 12, Fig. 2.

The description of the muscles now exposed will be given with that of the pharynx, Plate 13; attention is now directed to the manner in which they arise from the Eustachian tube. The vessels which enter between and behind them are palatine branches of the facial and ascending pharyngeal, a , b , c . Of these one is generally larger than the other, and often the supply comes from one artery alone. An anastomosis occurs between these vessels and branches of the internal maxillary.

The surgical operations for which a knowledge of the anatomy of this region are important, include in the first place the removal of polypi. If we exclude malignant tumours, which have sometimes been badly classed amongst them, polypi are of two kinds, the simple mucous growths and the fibrous polypi. The former are usually found on the turbinate bones, and, as a rule, nearer the roof than the floor; they scarcely ever occur on the septum. The rule therefore in removing them is simple—viz., to pass in the forceps as high as possible with the blades apart so as to grasp the pedicle of the polypus. Unless this be done, a portion only of the soft growth will be removed, and that which remains will be increasingly difficult to seize. Even if the growth spring from the inferior turbinate bone it will be probably success-

fully seized by this manœuvre; if not, the forceps must be introduced lower down with the blades separated vertically. It should be remembered that the posterior nares are altogether larger than the anterior (they measure one inch vertically by half an inch across), and that a polypus too large for extraction by the anterior nares may often after detachment be successfully pushed or drawn back into the pharynx. Large polypi often lie in the posterior nares over the soft palate, and may be felt there by the finger introduced into the mouth.

Fibrous polypi spring from any part of the nose, and often in the pharynx opposite the body of the sphenoid (nasopharyngeal). From their deep situation, the fact that they are not pedunculated, and that they often grow in various directions—*i.e.*, not only downwards into the pharynx and forwards into the nose, but backwards into the sphenoidal cells and outwards into the spheno-maxillary fossa—the latter are formidable subjects for removal. It may be done by evulsion, by the *écraseur* introduced through the mouth or the nose, in the latter case, either with or without enlarging the nares; or by turning back the upper jaw and replacing it after removal of the tumour. The surgeon must remember in dealing with these growths how near their point of origin is to the important structures within the cranium.

In plugging the posterior nares for epistaxis, a curved sound (Bellocq's) or catheter is passed through the nose round the palate and into the mouth. To its extremity is attached a cord fastened to the plug which is to be introduced. On its withdrawal the plug is drawn up into the nares.

In passing the Eustachian catheter it must be remembered that the orifice of the Eustachian tube is on a level with the posterior end of the inferior turbinate bone at a distance of about half an inch from the posterior wall of the pharynx. The easiest method of introduction is to pass it with the point down along the floor of the fossa, and at the same level beyond

it to the back of the pharynx, and then to withdraw the instrument while the point is at the same time rotated outwards. The less easy plan is to begin to rotate outwards as soon as the back of the hard palate is reached, and thus pass it directly into the orifice of the tube.

FIGS. 3, 4, AND 5

Represent a series of three dissections of the side of the nose and orbital region, with part of the cheek, from the front.

In Fig. 3, after removing the skin to the extent shown in the drawing, the parts exposed were simply cleaned by removing the fat.

MUSCLES.

Orbicularis palpebrarum, A, is an orbicular muscle surrounding the aperture between the lids. It consists of two parts: an external with comparatively dark fibres is attached to the inner margin of the orbit and to the tendo oculi (Fig. 4, A, A). Externally the fibres pass continuously round the margin of the orbit without being attached to bone. With its upper margin blends the *frontalis muscle*, H, and with the under surface of its upper part the corrugator supercilii (Fig. 4, H). The inner part of the muscle consists of pale fibres, and is not covered by fat; it covers the lids themselves. It is attached internally to the tendo oculi, and externally to the external tarsal ligament. Perforating the muscle are twigs of supra-trochlear 2, infra-trochlear 3, palpebral 4 and 5, and subcutaneous maxæ 6, nerves and various branches of the ophthalmic artery. It covers the margin of the orbit, the corrugator supercilii, the origins of the levator labii superioris, levator labii superioris alæque nasi, the supra-orbital nerve (which in this case also passed through it), the palpebral ligament, and then structures which afterwards pierce it.

Its action is to shut the eye. The inner part closes the

palpebral fissure, the outer brings down the eyebrow and draws up the skin of the cheek.

The *pyramidalis nasi*, I, is a small muscle without bony attachment. It blends above with the frontalis muscle, and is attached below to a fascia common to it and the compressor narium. It wrinkles the skin at the root of the nose.

The *compressor narium*, C, has a narrow origin from the superior maxillary bone above the canine tooth below that of the levator anguli oris, Fig. 4, C, and is inserted into the fascia common to it, and the pyramidalis. Its origin is beneath the elevators of the upper lip, its action to tighten the fascia over the nose and depress the lower part of the organ.

The *depressor alæ nasi*, Fig. 4, I, may be looked upon as a continuation of the last muscle; it arises from the incisor fossa on the superior maxilla; the fibres curve upwards and inwards, and are inserted into the ala of the nose and the lower part of the septum. It is covered by the orbicularis oris. Its action is to depress the wing of the nose.

The dilators of the wing of the nose are too small to show in an ordinary dissection.

The *levator labii superioris alæque nasi*, D, arises from the nasal process of the superior maxilla internal to the orbicularis palpebrarum, and is inserted partly into the wing of the nose and partly blends with the orbicularis oris. It is closely connected with the following muscle. It raises the wing of the nose and upper lip.

The *levator labii superioris*, E, arises from the superior maxillary and malar bones above the infra-orbital foramen, and blends below with the orbicularis oris. Between this and the following muscle is a mass of fat containing the infra-orbital vessels and nerve, and the part of the infra-orbital plexus of nerves. It raises the upper lip.

The *levator anguli oris*, F, arises from the canine fossa below the infra-orbital canal, and passing downwards, and slightly outwards, it blends with the outer part of the orbicularis oris,

and the fibres appear to be continued into those of the depressor anguli oris. It draws up the angle of the mouth.

The *corrugator supercilii*, Fig. 4, H, arises from the superciliary ridge on the frontal bone, and ends by blending with the upper part of the circumferential fibres of the orbicularis. It lies altogether beneath the orbicularis. Its action is to draw inwards the eyebrow and wrinkle vertically the skin at the inner end of the eyebrow.

The description of the vessels and nerves shown in this and the following figure will be found at pp. 69, 74, and 75. It is only necessary here to notice those which were not seen in Plates 7 and 8—viz., the *infra-trochlear*, 3, Figs. 3 and 4; the *subcutaneous malæ*, 6, Figs. 3 and 4, appearing at the point of junction of lines prolonged from the outer and lower margins of the orbit; and the terminal branch of the *nasal nerve*, Fig. 4, 11, appearing from beneath the compressor narium; and lastly, the small palpebral filaments from the supra-orbital, 4, lachrymal, 5, and infra-orbital, 7.

To make the dissection shown in Fig. 4, the orbicularis palpebrarum, the levator labii superioris, the levator labii superioris alæque nasi, the pyramidalis nasi, the frontalis, and the facial artery and vein were removed. The attachment of the orbicularis oris to the septum nasi was then cut, and the muscle turned down. The fat was then removed from the structures exposed.

The *palpebral ligament*, ¶, is a weak membrane passing from the margin of the orbit in front of the tarsi to the edge bounding the slit between the lids. It is thin in the middle, but thicker both internally and externally, where it is attached to the tendo oculi and the external tarsal ligament respectively.

MUSCLES.

For the description of the *corrugator supercilii*, see above, and of the *depressor alæ nasi*, see p. 101.

In order to make the dissection shown in Fig 5, all the

muscles previously exposed were taken away, and the whole of the left half of the upper lip was removed by prolonging the vertical incision down into the mouth. The palpebral ligaments were then taken away, and the structures exposed behind them cleaned. The cartilages of the nose were defined. Lastly, the lachrymal sac being shown, the superior maxillary bone was chipped away below the inner part of the orbit, so as to show the ductus ad nasum, in doing which the antrum of Highmore was necessarily opened.

The *cartilages of the nose* have been all shown in this plate and the accompanying woodcuts.

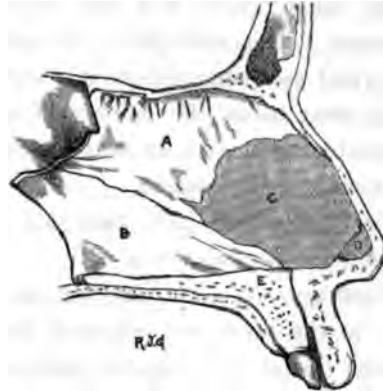
The *lateral cartilage*, ☉, is triangular in shape. It is attached behind to the nasal and superior maxillary bones; towards the middle line it is continuous with the edge of the cartilage of the septum, of which it may be regarded as a prolongation; below it is separated by a narrow interval occupied by fascia from the cartilage of the aperture.

The *cartilage of the aperture*, =, consists of two flattish portions united at a somewhat rounded acute angle. The smaller lies in contact with its fellow in the middle line, and forms with it the lower part of the septum nasi or columella. The larger, more or less oval in shape, curves upwards and backwards along the outer side of the nostril. The extremity is thin and pointed, and is either folded or broken up into minute cartilaginous masses. Other similar ones (*cartilagine epactiles*, or *cartilagine sesamoideæ*) are found at its upper border near the middle line.

The prominence of the angles between the two parts gives the shape to the tip of the nose, and the width of the groove between them has also a great influence on its character.

The *cartilage of the septum*, ||, (woodcut, p. 104) is irregularly quadrilateral, its two posterior edges being in contact with the anterior part of the perpendicular plate of the ethmoid, and the upper part of the vomer and nasal spine; while of the anterior edges, the upper is placed between the lateral cartilages

but reaching below their lower borders, and the lower is in contact with the upper border of the inner part of the



A, Vertical plate of ethmoid.
B, Vomer.
C, Cartilage of septum.

D, Cartilage of aperture.
E, Palatal processes of superior maxillary and palate bones.

cartilage of the aperture. This cartilage is thicker at the circumference than in the centre; it is indented behind where it is in contact with the ethmoid and vomer. It is almost always to one side or other of the middle line.

Many of the structures seen in the front of the orbit are described with Plate 12. It will be noticed that the *supra-trochlear nerve*, 2, leaves the *frontal*, 1, much nearer the anterior aperture of the orbit than usual.

The *lachrymal apparatus* consists of the gland and the ducts by which the tears are conducted to the nose.

The anterior end of the *lachrymal gland*, ξ , is seen close to the external angular process, the gland itself (Plate 12, Figs. 3, 4, and 5) is of a long ovoidal shape, and occupies a deepish hollow at the upper and outer angle of the orbit. Its ducts, twelve or fourteen in number, open on the conjunctiva of the upper lid at its upper and outer part.

The *puncta lachrymalia*, situated just internal to the

references * and +, are small apertures on the summits of the lachrymal papillæ on each lid near the inner canthus. They lead to the *canaliculi*, which are shown in the drawing. These minute canals have at first an almost vertical direction in both lids, and then pass nearly horizontally inwards behind the bifurcations of the *tendo oculi*, †, to open into the *lachrymal sac*, ¶. This is the dilated upper extremity of the ductus ad nasum, and occupies a deep groove on the upper maxillary and lachrymal bones. It is in close contact with the *tendo oculi*, which crosses it about its middle, and is covered by a strong layer of fascia (drawn forwards as shown in the drawing). The small tensor tarsi muscle is behind it.

The *ductus ad nasum* (see also Plate 12, Fig. 2) occupies a canal formed by the superior maxillary lachrymal and inferior turbinate bones. It is six or seven lines in length, and is directed downwards, and slightly outwards and backwards. It opens into the inferior meatus by a narrow orifice guarded by a fold of mucous membrane (see Plate 12). Several valves formed by the mucous membrane have been described in connexion with the sac and duct.

In passing a probe into the canaliculi, as is frequently done in order to slit them up for the sake of curing an epiphora or overflow of tears, it is important to bear in mind their direction. After this is done, if the direction of the duct be remembered, there will be no difficulty in passing the probe or style down the nasal duct. If it be intended to open the sac without interfering with the canaliculi, the *tendo oculi* may be made tense by drawing the lids outwards, and a narrow knife introduced just above it; it is then flattened against the forehead and pushed in the same direction as the probe in the last instance—i.e. downwards and slightly outwards and backwards.

PLATE 11.

FIG. 1

REPRESENTS the dissection usually made to expose *Meckel's ganglion*.

The head having been divided by a vertical and longitudinal saw-cut slightly to the right of the middle line, the left side is chosen for the preparation. Plate 10, Fig. 1, represents the appearance of the septum nasi as it is then seen; this was taken almost completely away with the vessels and nerves in contact with it. The mucous membrane was then stripped off from the hard palate as far outwards as the line of the posterior palatine canals, and the vessels and nerves emerging from them were shown on the upper surface of the membrane removed. The mucous membrane was then removed from the back of the nasal fossa as far forward as a line drawn downwards from the sphenopalatine foramen, below which the position of the posterior palatine canals was indicated by the injected vessels showing through the bone; the bones (palate, superior maxillary, inferior turbinated, and ethmoid) were then chipped away both in the hard palate and outer wall of the nose so as to expose these vessels and nerves, and in connexion with the upper part of the latter the ganglion was found. To expose the superior maxillary nerve with its descending branches to the ganglion and the small ascending branches of the latter and to open the cavity of the orbit, the upper part of the ethmoid with the two upper spongy bones, and parts of the horizontal plate of the frontal and of the body of the sphenoid were removed; and to open the Vidian and pterygo-palatine canals a larger part of the body of the sphenoid and the root of the pterygoid process were taken away. In this dissection the internal carotid artery was brought into view and part of it removed.

Lastly, the periosteum and some fat were taken from the inner side of the orbit so as to expose the structures contained in it.

The *uvula* is occupying a normal position opposite the long body of the second vertebra; the mucous membrane of the hard palate would not touch the upper surface of the tongue when the mouth is opened as in the drawing, unless it had been separated from the bones. The position of the *epiglottis*, β , is opposite the fourth vertebra and parts of the vertebræ above and below it. The *cricoid cartilage*, δ , is opposite the body of the sixth and part of the fifth vertebræ. The *vocal cords*, ϵ , thus occupy a position opposite some part of the body of the fifth vertebra, while the *hyoid bone*, $+$, corresponds to some part of the fourth. It will be remembered that while these structures are all raised during deglutition and very slightly during forcible opening of the mouth, they may easily be displaced downwards in the dissected subject.

The continuity of the *dura mater* in the skull and spinal canal is shown, and the loose attachment of the membrane in the latter as compared with its firm adherence to the bones in the former is also indicated. Just above the first vertebra the vertebral artery, k , pierces the *dura mater*, and in the intervals between the vertebræ the trunks of some of the upper cervical nerves.

The reader will notice the opening of the *Eustachian tube*, ξ , as well as the *frontal sinus*, η , and the *antrum of Highmore*, τ , which are described elsewhere.

MUSCLES.

The *genio-hyo-glossus*, A, *genio-hyoid*, B, and *mylo-hyoid*, C, have been shown in several of the preceding plates and described at pp. 41, 40, and 33 respectively. If the tongue had been divided exactly in the middle line, its fibrous septum would have been seen interfering with the continuity of the fibres of the *genio-hyo-glossus*.

The muscles of the orbit are described at p. 121.

ARTERIES.

The left *internal carotid*, *a*, has been shown from the inner side in the last part of its course by removing the sella turcica. A small portion of it has been cut away in order to expose the Vidian nerve as far as possible. The *vertebral*, *k*, is seen at the point where it perforates the dura mater.

Some of the terminal branches of the internal maxillary are now seen—viz. :

Vidian, *g*, a small branch runs directly backwards with the Vidian nerve through the canal of the same name. At the posterior extremity of this it turns outwards through the cartilage filling the foramen lacerum medium, and passing with its nerve under the Casserian ganglion on the upper surface of the petrous bone, anastomoses with a branch of the middle meningeal and enters the hiatus Fallopii to end by sending a twig to the tympanum ; it supplies branches to the Eustachian tube and pharynx.

Pterygo-palatine, *h*, a very small twig runs back through the pterygo-palatine canal and sends twigs to the pharynx, Eustachian tube, and sphenoidal cells.

The *spheno-palatine* or nasal, *e*, enters the nose by the spheno-palatine foramen and sends branches to the posterior ethmoidal cells, the antrum, the spongy bones, and the septum ; one of the last is a long branch, the *naso-palatine* or *artery of the septum*, *i*, of which the greater part has been taken away with the septum nasi. It runs downwards and forwards obliquely across the septum nasi, passes through the incisor foramen—i.e., through the foramen on its own side of the septum by which the anterior-palatine foramen is traversed, and ends by anastomosing in the hard palate with the descending-palatine. The artery is better seen in Plate 10, Fig. 1.

The *descending-palatine*, *f*, passes with the large descending-

palatine nerve through its canal, at the lower end of which it runs forwards in the mucous membrane of the hard palate to end by anastomosing with the termination of the artery of the septum. As it descends it supplies branches which pass down with the two smaller nerves, and supply the soft palate and tonsil, anastomosing with the palatal branches of the facial : other branches are supplied to the mucous membrane of the nose.

NERVES.

The *superior maxillary*, 6, is seen as it passes across the spheno-maxillary fossa. It gives off at this point two descending branches, *spheno-palatine*, in connexion with which is the *spheno-palatine* or *Meckel's ganglion*, 7. The size of this in the drawing is, for the sake of clearness, exaggerated. It receives posteriorly the *Vidian* nerve, which is connected at its other extremity with the facial and the tympanic plexus, under the name of the great superficial petrosal, and receives twigs from the carotid plexus of the sympathetic in its passage through the foramen lacerum medium. From the lower part of the ganglion the *descending-palatine* nerves pass downwards; they may be considered as prolongations of the spheno-palatine branches mentioned above, and are three in number. The large, or *anterior*, 10, passes through the large canal, giving off a branch to the nose as it descends; it afterwards passes forwards in the mucous membrane of the roof of the mouth almost to the incisor teeth. The small, or *posterior*, 11, passes through the posterior canal to the soft palate, tonsil and uvula, and is said by Meckel to supply the levator palati and azygos uvulæ. The smallest or *external*, if present, passes through the external canal, and sends branches to the uvula, tonsil and soft palate. The *naso-palatine*, 9, passes with the artery of the same name obliquely downwards and forwards across the septum, to which it supplies branches, then through one of the mesial openings in the anterior palatine canal, that of the left side being anterior, and ends in the mucous membrane of the

mouth behind the incisor teeth where the nerves of the two sides communicate.

The reference, 12, is placed upon the second cervical nerve as it pierces the dura mater. Three others of the same series are shown below.

FIG. 2.

This figure illustrates the dissection to expose the *otic ganglion*.

In a skull which has been sawn vertically and longitudinally just to the left of the middle line, the tensor and levator palati, and the Eustachian tube, are first prepared, as in Plate 10, Fig. 2. The tube is then carefully separated from the temporal and sphenoid bones, and the levator is cut close to its origin. The tensor is divided below and turned up carefully, and then either the anterior or the posterior part of its origin is detached, and the muscle turned backwards or forwards as the case may be, whilst the nerve which enters it is preserved. The bone is then chipped away with bone-forceps behind a line leading from the back of the root of the pterygoid process into the foramen ovale, and another vertical incision is carried from the foramen magnum obliquely forwards and outwards to the same foramen. The Eustachian tube is then cut short, and the parts which have been exposed are cleaned.

Lastly, in this particular preparation, some of the body of the sphenoid was removed with a chisel, so as to expose the Casserian ganglion more fully, and the mucous membrane of the mouth and nose was separated from the bones.

The relations of the *styloid process*, 11, and the muscles arising from it to the two carotid arteries are well seen. It passes between the two vessels, and thus, while the stylo-pharyngeus, E, and stylo-hyoid, F, which arise from its base pass one inside and the other outside the external carotid, the stylo-

glossus, D, which is attached near the apex does not come into relation with either vessel.

The best view of the *internal pterygoid*, A, is obtained from the inner aspect; it is described at p 98.

NERVES.

As in Fig. 1, it must be remembered that the size of the otic ganglion and the small nerves passing from it has been exaggerated.

The *otic ganglion*, 5, more or less round in shape, is situated immediately below the foramen ovale, internal to the inferior maxillary nerve, 3, and upon the branch of this nerve to the internal pterygoid muscle, 9. It receives and transmits the following branches :—

The *small superficial petrosal*, 6, passes upwards and backwards from the ganglion to a small foramen near the foramen spinosum, or through the petro-sphenoidal suture; from this it passes through a canal in the petrous part of the temporal to join the intumescencia gangliformis of the facial and the tympanic plexus. In this course it sometimes reaches the upper surface of the temporal bone, as in Plate 12, Fig. 4.

It also receives communicating twigs from the sensory branches of the inferior maxillary, especially the auriculo-temporal one such is shown as well as one joining the gustatory.

It supplies muscular twigs to the *tensor tympani*, 7, and to the *tensor palati*, 8.

The other nerves exposed have been described elsewhere; it will be observed that the junction of the *chorda tympani*, 14, with the *gustatory*, 11, and the double origin of the *auriculo-temporal*, 13, are well shown in such a dissection.

PLATE 12.

FIG. 1.

THE dissection shown in this drawing was made in the following manner:—After the removal of the scalp two vertical saw-cuts were carried through skull, dura mater, and brain from before backwards, each about half an inch from the middle line, from the superciliary ridge to about an inch above the level of the occipital protuberance. The ends of these incisions were joined by two horizontal cuts carried to the same depth, so that two wedges, consisting of brain, dura mater, and bone, were removed. As the subject was not perfectly fresh the softened brain was easily scooped away with the fingers, helped by a stream of water, whilst the arteries supplying the brain were left *in situ*. These latter were afterwards cut short.

By looking down at the skull obliquely from one side and behind, a view may be obtained of the folds of the dura mater, except the falx cerebelli, and of all the cranial nerves except the hypoglossal.

The *dura mater*, a strong membrane composed of interlacing bands of white fibrous and elastic tissue, and covered on its internal aspect by a layer of epithelium, the so-called parietal layer of the arachnoid, is divisible into two layers: an external, which is closely adherent to the bones of the skull, to which it forms the internal periosteum, and an inner, which along a certain number of lines projects inwards, so as to form folds which separate parts of the brain. Along these lines run venous canals, which are triangular in section, being bounded on two sides by the inner layer, and on the other by the outer layer of the dura mater, and lined by venous

epithelium. Similar canals, but without the definite triangular shape in section, exist in other parts of the dura mater. These canals are the sinuses. The dura mater is most firmly attached to the bone at the sutures and at the base of the skull. Prolongations of it are sent through the foramina, which are continuous in part with the pericranium, in part with the sheath of the nerves. The folds formed by the inner layer are as follows:—

The *tentorium cerebelli*, η , is a somewhat horizontal septum between the cerebrum and cerebellum; it is considerably raised in the centre, and has a large oval deficiency in front, so as to give it the appearance of a very flat pointed tent. It is attached on each side to the anterior and posterior clinoid processes, to the upper border of the petrous portion of the temporal bone, and to the lateral sulcus on the mastoid, parietal, and occipital bones. Along the middle line is attached the base of the *falx cerebri*. The opening is occupied by the *crura cerebri*, superior peduncles of cerebellum and corpora quadrigemina, surrounded by the membranes and the posterior cerebral arteries.

The *falx cerebri*, θ , is of a broad sickle shape. The point is attached to the crista galli; the base is behind, and is attached to the tentorium, the concave edge looks downwards towards the corpus callosum, and the opposite border is attached along the longitudinal sulcus to the frontal, parietal, and occipital bones.

The small *falx cerebelli* is not shown; it is a small triangular fold. The apex is downwards and forwards; it is bifid, the two parts passing on each side of the foramen magnum. The base is attached to the under surface of the tentorium opposite, but for a shorter distance than, the *falx cerebri*; the edge projects between the lobes of the cerebellum, and the opposite side is attached to the internal occipital crest.

The *superior longitudinal sinus*, α , begins at the crista galli, and runs backwards to the internal occipital protuberance, where it joins the *torcular Herophili*, δ ; this last is an irregular

cavity, occupying the hollow formed by the junction of the lateral and longitudinal sulci, which receives, as will be seen, the straight and occipital sinuses, and from which pass the two lateral sinuses.

The *straight sinus*, γ , occupies the line of junction of the tentorium and falx cerebri; it receives at its anterior extremity the inferior longitudinal sinus and the veins of Galen.

The *inferior longitudinal sinus*, β , begins near the crista galli, and runs backwards in the edge of the falx.

The *veins of Galen*, ζ , come from the interior of the brain, where they lie in the velum interpositum beneath the fornix.

The *occipital sinus*, which is sometimes absent, lies in the falx cerebelli. It is bifid below, and communicates with the spinal veins.

The *lateral sinus* takes a curved course along the lateral sulcus, across the occipital, parietal, and temporal bones, and ends by forming the internal jugular vein at the jugular foramen. It is joined by the superior petrosal sinus.

The *superior petrosal sinus*, ϵ , lies along the upper border of the petrous portion of the temporal bone, connecting the lateral and cavernous sinuses.

The *cavernous sinus* is an irregular cavity on the side of the body of the sphenoid bone. It is seen at Fig. 4, δ . It is more or less triangular in transverse section, having an inner and an outer wall, and a floor. Occupying the inner wall and floor is the internal carotid artery, which is crossed on the outer side by the sixth nerve, Fig. 4, 10. In the outer wall are the third, fourth, and ophthalmic divisions of the fifth nerves. The sinus receives in front the ophthalmic vein, and communicates internally with its fellow of the opposite side by means of the circular and the basilar sinuses; it sends backwards the superior petrosal sinus, and is prolonged downwards into the inferior petrosal sinus. It receives its name from a number of fibrous trabeculae by which its cavity is traversed.

The *circular sinus* surrounds the pituitary body.

The *basilar* or *transverse sinus*, Fig. 4, passes across the basilar process of the occipital, and joins the inferior petrosal, sometimes the cavernous sinuses. There are generally two or more small sinuses on the basilar portion of the occipital which communicate below with the spinal veins.

The *inferior petrosal sinus*, Fig. 4, γ , grooves the apex of the petrous and side of the body of the sphenoid bones, and then the line of junction of the petrous and occipital, as it runs backwards, downwards, and outwards to reach the anterior part of the jugular foramen, through which it passes to join the commencement of the internal jugular vein.

These sinuses differ from veins in the peculiarity of their shape and the rigidity of their walls, in the absence of valves, and the existence in many of them of small trabeculæ crossing from side to side. These trabeculæ are distinct in the cavernous sinus, where they are soft and red, and in the superior longitudinal sinus, where they are white and stronger (chordæ Willisii). The sinuses receive their blood from various sources: principally from the brain, but also from the dura mater, the diploë, the orbit, the ear, and by emissary veins passing through the skull they communicate with some of the external veins. The surgeon must bear in mind the situation of the superior longitudinal and lateral sinuses in order to avoid them in trephining; that of the former is unmistakable; that of the latter corresponds to a line drawn from the occipital protuberance towards the upper border of the zygoma, as far as a point vertically above the mastoid process. The sinuses may be wounded in fractures of the skull and extensive hæmorrhage may result. Hæmorrhage from them must be arrested by plugging.

In the course of some diseases, and notably in pyæmia, and caries of the temporal bone in connexion with disease of the ear, one or more of the sinuses may become obstructed by clots; it is a subject of doubt if any of the symptoms which follow can be traced to a resulting œdema of the brain. It

will not be forgotten that the ophthalmic vein communicates with the facial, and that therefore œdema of the orbit does not necessarily follow obstruction of the cavernous sinus. Inflammation of the cavernous sinus in the course of facial erysipelas has been described and traced to the existence of this intercommunication.

The brain is supplied by the internal carotid and vertebral arteries. The *circle of Willis*, which is here shown *in situ*, is thus formed. Close to the two anterior clinoid processes, the *internal carotid arteries*, *a, a*, divide into the *anterior cerebrals*, *b, b*, the *middle cerebrals*, *d, d*, and the *posterior communicating arteries*, *e, e*. The anterior cerebrals are joined close in front of the groove for the optic commissure by the short *anterior communicating*, *c*. The posterior communicating arteries run backwards near the edge of the falx to join the posterior cerebrals which are passing forwards from the *basilar*, *g*, of which they are the terminal branches. The basilar is formed by the junction of the two *vertebrals*, *f*, which after piercing the dura mater between the atlas and occipital bone, Plate 11, Fig. 1, *k*, pass up through the foramen magnum and unite together on the basilar portion of the occipital bone. Without specifying the course of these arteries, two or three points about them may be mentioned. Several of the *transverse arteries* are figured, from one of them, *h*, is shown the small *acoustic artery*, entering the internal auditory meatus. The third nerve, *2*, passes between the posterior cerebral, *k*, and the superior cerebellar, *l*; the sixth nerve is crossed by one or more of the transverse arteries. It will be noticed that the arteries are far from symmetrical on the two sides; for example, the right anterior cerebral comes equally from the two carotids, and the right posterior cerebral chiefly from the right carotid. Such variations are, however, more common than absolute symmetry.

The free inosculation between the vessels entering into the formation of the circle of Willis allows of a sufficient supply of

blood reaching the brain if one of its principal feeding trunks be obliterated. Such obstruction may occasionally, though rarely, occur as the result of a clot washed into the circulation from the heart, or it may be produced by ligature of the common carotid. If a clot, however, pass into one of the *branches* of the circle, that portion of the brain to which it goes is deprived of its supply of blood, and stasis with cerebral hæmorrhage are the result; the left middle cerebral is the artery in which such an obstruction most commonly occurs.

The positions at which the cranial nerves pierce the dura mater may now be studied. About the *first*, and the *second*, 1, nothing need be said; the *third*, 2, perforates the edge of the tentorium close to the anterior clinoid process; the *fourth*, 3, the free edge of the tentorium a little further back; the *fifth*, 4, immediately below the tentorium; the *sixth*, 5, lower down than the fifth and nearer the middle line, almost directly behind the third; the *seventh*, 6, and *eighth*, 7, go respectively through the internal auditory meatus and the jugular foramen; the former consists of the smaller *facial* in front and larger *auditory* behind, and the latter of the *glossopharyngeal* externally, which passes through a special opening in the dura mater, the *spinal accessory* internally, passing upwards from the foramen magnum, and the large *pneumogastric* between the two. If the *hypoglossal* were visible it would be seen to consist of two parts, and to pass through the anterior condyloid foramen.

The long course of the sixth nerve on the base of the skull **is** to be considered in connexion with the fact, that in very many diseases of the brain in which swelling, general or local, **is** one of the factors, the sixth is the first nerve to suffer. **I**t may also be remembered that, from its position near the middle line between the pons and the bone, it can receive but little protection from the presence of cerebro-spinal fluid, as compared with the other nerves; these two facts will probably account for its greater liability to feel the effects of pressure.

FIGS. 2, 3, 4, AND 5.

The remaining figures of this Plate show various dissections of the orbit. A description of the method by which each was made will first be given, and then a general account of the structures exposed.

Fig. 2 shows the orbit as seen from inside.

The dissection was made on a skull which had been sawn vertically to the right of the middle line. The mucous membrane was removed as far back as the spheno-palatine foramen, except in the inferior meatus and floor of the nose; and the turbinate bones were cut away. The inner wall of the orbit was then taken away by chipping, with bone-forceps, the front of the sphenoid, the lateral mass of the ethmoid, the lachrymal and small portions of the frontal and superior maxillary bone, as far backwards as the spheno-palatine canal, as far downwards as a horizontal line drawn from the same opening, and as far forwards as the front of the middle turbinate bone.

The periosteum of the orbit thus exposed was then removed, showing the structures seen in the drawing. Another quarter of an inch was then sawn off the basilar processes of the occipital and body of the sphenoid, and the bone was chipped away from around the ductus ad nasum.

The reader will notice the groove, ξ , corresponding to the end of the *infundibulum*, and the relation to it of the opening into the antrum, o ; the communication between what is left of the *posterior ethmoidal cells*, δ , and the *sphenoidal sinus*; the valvular opening, ν , of the *nasal duct*, p. 105; and the inner view here obtained of the lateral cartilages of the nose, p. 103. The *frontal sinus*, π , here extended far back, but was not opened in the original section of the skull. The width of the *internal rectus*, A , will not be forgotten, nor the complete manner in which it hides the other structures in the orbit, as seen from this aspect. This dissection should be compared with that shown in Plate 11, Fig. 1, in which more of the bone has been taken away.

Fig. 3 shows the orbit as seen from the outer side.

The dissection was made by carrying two horizontal incisions : one just below the level of the zygoma from the most prominent point of the malar bone almost to the articulation of the jaw, and another, of equal length and parallel with it, at the level of the upper margin of the orbit. These were joined at their extremities by vertical incisions, the anterior of which passed across the eyelids. In the subcutaneous tissue were branches of the temporo-malar, 2 and 3, and facial, 1, nerves, and of the temporal, transverse facial, *c*, and lachrymal, *e*, arteries; beneath it was the temporal, *E*, and masseter, *F*, muscles covered by their fasciæ, the orbicularis palpebrarum, and the zygoma.

The three muscles were removed as far as uncovered, thus exposing the margin of the orbit and the palpebral ligament, the great wing of the sphenoid, *ζ*, and part of the squamous portion of the temporal. As much of the zygoma as was exposed was then taken away, showing the external pterygoid muscle, *G*, and the internal maxillary artery, *a*, passing into the spheno-maxillary fossa. The palpebral ligament was then divided, and as much as possible of the outer wall of the orbit was taken away, by sawing, in the first place, through the malar bone into the spheno-maxillary fissure, and then chipping away the rest, formed by the malar, sphenoid, and frontal bones, with the bone-forceps and chisel, taking care not to injure the two branches of the temporo-malar nerve, 2 and 3, and the artery accompanying it. In this way the periosteum of the orbit was exposed, and, after its removal, the structures seen in the orbit were displayed and cleaned. Lastly, the tarsi and the conjunctiva, *β*, were cut opposite the original anterior incision.

The description of this will be given with that of the other drawings of the orbit. It may be remarked, however, that a complete external view of the orbit cannot be obtained without opening into the skull, which fact is an indication of the distance of the apex of this cavity from the surface. The small artery, *b*, accompanying the branches of the temporo-malar

nerve, in this instance, undoubtedly came from the internal maxillary. The junction, 4, between the temporo-malar and the lachrymal is shown, as well as that between the temporal branch and the facial; the malar branch, in this instance, as sometimes happens, did not occupy the same foramen as the small artery which usually accompanies it, but passed outwards through the spheno-maxillary fissure and round the edge of the malar bone, supplying at last, however, its usual area of skin. The nerve is liable to considerable variation.

Fig. 4 shows the Casserian ganglion and the parts around, and the superficial view of the orbit from above.

The dissection was obtained from that shown in Fig. 1, by removing the falx with the arch of bone to which it was attached, and the circle of Willis; then on the left side, by chipping away carefully the roof of the orbit, after removing the dura mater from the anterior fossa, and on the right by simply removing with great care the dura mater from the middle fossa.

Fig. 5 shows two deeper views of the orbit from above. It was made from that shown in Fig. 4, as follows:—

On the right side the dissection was first carried to the same point as that in the left side of Fig. 4; the small wing of the sphenoid was then chipped away so as to open the sphenoidal fissure. The common trunk of the frontal and lachrymal nerves, 6, and the supra-orbital, *c*, and lachrymal, *d*, vessels, the levator palpebræ superioris, B, and the superior rectus, C, were thrown forwards. Lastly, the ophthalmic vein, *a*, was partly removed. The structures seen were then exposed and cleaned. On the left side the dissection was first carried to the same stage as that already described. The frontal bone was then sawn through by vertical cuts opposite the inner and outer walls of the orbit, and the piece of bone so separated was taken away. The superior oblique, A, and the fourth nerve, 4, were cut and turned forwards, and then the optic, 2, and ciliary, 15 and 9, nerves with the posterior ciliary vessels, *e*,

were divided, after which the eyeball was turned forwards, and the parts exposed were cleaned. Lastly, the optic foramen was opened, and the anterior clinoid process was chipped off, and the remaining dura mater cleared away from the fifth and sixth nerves.

General Description of Figs. 2, 3, 4, and 5.

MUSCLES.

Superior rectus, Fig. 3, A, Fig. 4, C, arises from the upper part of the optic foramen, and is inserted, Fig. 5, C, into the upper part of the sclerotic a third of an inch behind the margin of the cornea. The levator palpebræ superioris is in contact with it superficially; it rests upon the optic and nasal nerve, ophthalmic artery, and the eyeball. It raises the eye.

Inferior rectus, Fig. 3, C, Fig. 5, F, arises from the lower part of the optic foramen by a tendon common to it and the internal and external recti, and is inserted into the sclerotic opposite the superior rectus. It rests upon the floor of the orbit and the inferior oblique, and is covered by the optic nerve and the eyeball. It depresses the eye.

Internal rectus, Fig. 2, A, Fig. 5, E, arises from the inner part of the optic foramen, and is inserted into the inner part of the sclerotic midway between the superior and inferior recti. It is in relation externally with the optic nerve, the ophthalmic artery, the nasal nerve, and the eyeball; internally it touches the inner wall of the orbit. It draws the eye inwards.

External rectus, Fig. 3, B, Fig. 5, D, arises by two heads, one in common with the superior rectus, and the other partly with the inferior rectus, and partly from the lower border of the sphenoidal fissure. It is inserted opposite the internal rectus. Internally it is in contact with the optic nerve, the ophthalmic artery, and the lenticular ganglion with its branches; externally it touches the outer wall of the orbit. Between its heads the following structures pass: the two divisions of the

third nerve separated by the nasal nerve, and below them the sixth nerve and the ophthalmic vein. Its action is to draw the eye outwards.

The *levator palpebræ superioris*, Fig. 4, B, Fig. 5, B, arises slightly in front of the inner part of the origin of the superior rectus, and it is inserted into the lower margin of the anterior surface of the upper tarsus. Superficial to it are the fourth and frontal nerves, and the supra-orbital artery, Fig. 4, c. It rests upon the superior rectus. Its action is to raise the upper eyelid.

The *superior oblique*, Fig. 2, B, Fig. 4, A, Fig. 5, A, arises near the optic foramen internal and anterior to the origin of the levator palpebræ; it passes forwards to the inner and upper angle of the orbit, where it ends in a tendon, which, after passing through a small fibrous pulley, turns backwards, outwards, and downwards, to be inserted into the sclerotic behind and outside the insertion of the superior rectus, midway between the optic nerve and the cornea. One edge is in contact with the internal rectus, the nasal artery and nerve intervening. The ocular surface looks towards the ophthalmic vessels and the eyeball; the other surface is directed towards the wall of the orbit and fourth nerve.

The *inferior oblique*, Fig. 3, D, Fig. 5, G, arises from an impression at the inner and anterior part of the floor of the orbit. It is directed outwards, upwards, and backwards, beneath the inferior rectus, but internal to the external rectus, and is inserted into the posterior and outer part of the sclerotic, behind the insertion of this last muscle, or between it and the superior rectus.

The actual use of the oblique muscles must be considered as still open to question; it is supposed that the tendency of the superior and inferior recti to turn the eyeball *inwards* which arises from the position of their origins internal to the antero-posterior axis of the eye may be counteracted by a rotation, *outwards and upwards*, imparted by the inferior oblique, *outwards*

and downwards by the superior oblique. From this point of view the superior oblique is to be looked upon as the assistant of the inferior rectus, and the inferior oblique as that of the superior rectus.

ARTERIES.

The attention of the reader is directed to the different views that are given of the *internal carotid* as it passes through the cavernous sinus. The description of it will be found at p. 87; one of the small *arteriæ receptaculi* is shown in Fig. 4.

The *ophthalmic* leaves the artery either just before or just after it pierces the *dura mater*, Fig. 5, *b*. It enters the orbit by the optic foramen outside and below the optic nerve, and after crossing over this nerve so as to reach its inner side, it takes a tortuous course forwards to the inner angle of the orbit to terminate in nasal and frontal branches at the root of the nose, where it anastomoses with the angular branch of the facial. It supplies the following branches:—

The *lachrymal*, Fig. 4, *d*, Fig. 5, *d* and *k*, runs outwards superficial to the muscles to the lachrymal gland, and eyelids. It sends branches back through the sphenoidal fissure and the great wing of the sphenoid to anastomose with the middle meningeal. One of these is often of large size, or may even constitute the whole of this artery, as in Fig. 5, *k*. Other branches accompany the divisions of the temporo-malar nerve and anastomose with the temporal and transverse facial arteries unless these are supplied by the internal maxillary, as in Fig. 3.

The small *arteria centralis retinae* enters the substance of the optic nerve a quarter of an inch from the eyeball, and runs forward in it to supply the retina.

The *supra-orbital*, Fig. 4, *c*, leaves the artery as it crosses the optic nerve, and becoming superficial between the levator palpebræ and superior oblique, it runs directly forwards over the former with the frontal nerve, and ends by passing through the supra-orbital foramen to the forehead.

The *ciliary branches* are divided into *posterior*, Fig. 5, *e*, and *anterior*; the latter are not shown, they are derived from the muscular branches and pierce the anterior part of the sclerotic; the former pierce the sclerotic round the entrance of the optic nerve.

The *muscular branches* are irregular in their origin; they supply the muscles of the orbit.

The *posterior ethmoidal*, Fig. 2, *d*, Fig. 5, *g*, passes inwards through the posterior internal orbital canal and supplies branches to the dura mater, the sphenoidal sinus, and the nose; its branch to the septum is sometimes of considerable size, Plate 10, Fig. 1.

The *anterior ethmoidal*, Fig. 2, *c*, Fig. 5, *f*, has been already seen in Plates 10 and 11. It first passes inwards through the anterior internal orbital canal with the nasal nerve, then it runs forwards in the cavity of the cranium supplying branches to the dura mater, Fig. 4, *e*, as far as a foramen by the side of the crista galli, through which it enters the cavity of the nose; there it gives off a branch to the septum and is continued by one or two branches on the inner aspect of the nasal bone to the interval between it and the lateral cartilage, through which it passes to end on the face by anastomosing with the facial.

Two small *palpebral branches* leave the ophthalmic artery at its termination for the supply of the lids.

VEIN.

The *ophthalmic vein*, Fig. 5, *a*, is very tortuous; it commences at the root of the nose by joining the angular vein, and runs backwards along the upper and inner angle of the orbit, receiving branches corresponding with those of the artery. It communicates externally with the pterygoid plexus, and ends by passing between the heads of the external rectus to join the cavernous sinus.

NERVES.

The *optic nerve*, Fig. 5, 2, after leaving the optic commissure,

passes through the optic foramen, and is directed forwards and outwards to the back of the eye. It is surrounded by the origins of the recti and ciliary nerves and vessels, and it is crossed by the nasal nerve and ophthalmic artery.

The *third nerve*, Fig. 4, 2, Fig. 5, 3, after piercing the dura mater, as has been said, runs forward to the sphenoidal fissure above the ophthalmic division of the fifth, being crossed on the outer side by the fourth nerve, and the frontal and lachrymal of the fifth. It enters between the two heads of the external rectus, after dividing into two parts : an upper, which supplies the superior rectus and levator palpebræ superioris, and a lower, supplying the inferior and internal recti and the inferior oblique. The last nerve is a long one, which, after coursing along the upper surface of the inferior rectus, enters the inferior oblique at its posterior edge. It supplies, near its commencement, the short root of the lenticular ganglion.

The *fourth nerve*, Fig. 4, 3, Fig. 5, 4, at first below the third nerve, crosses over its outer side so as to be above it in the sphenoidal fissure. It then crosses the superior rectus and levator palpebræ to enter the superior oblique at the outer part of its orbital surface.

The *fifth nerve*, Fig. 4, 5, Fig. 5, 5, after piercing the dura mater, dilates into the *Casserian ganglion*, Fig. 4, 6. This is a large, reddish, oval body occupying a hollow on the apex of the petrous portion of the temporal bone. From its outer part are given off the three trunks of the nerve, with the first of which only we have now to deal. It is covered by dura mater, and near its outer edge are the three small petrosal nerves, Fig. 4, 17, 18, 19, before described, p. 89.

The *ophthalmic nerve*, Fig. 4, 7, leaving the fore-part of the ganglion, is directed forwards and upwards to the sphenoidal fissure. Soon after leaving the ganglion, it gives back the small *recurrent branch*, 4, which is said to run backwards in the sheath of the fourth nerve and end in the tentorium. Before reaching the sphenoidal fissure the nerve divides into two parts :

the smaller and lower is the nasal, Fig. 5, 7; the upper and larger, Fig. 5, 6, which is really the continuation of the nerve, divides, on entering the fissure, into the *frontal*, Fig. 4, 13, and the *lachrymal*, Fig. 4, 16, Fig. 3, 5. The ophthalmic is the smallest branch of the ganglion; it is about an inch long, and lies in the outer wall of the cavernous sinus. Twigs have been described uniting it with the third, fourth, sixth, and the cavernous plexus.

The *frontal*, Fig. 4, 13, passes forward superficial to the superior rectus and levator palpebræ, and divides midway across the orbit into the *supra-orbital*, Fig. 4, 14, and *supra-trochlear*, Fig. 4, 15, before described, p. 69.

The *lachrymal*, Fig. 4, 16, enters the orbit like the last superficial to the muscles, and is directed forwards and outwards along the upper and outer angle to the lachrymal gland which it supplies. It is joined by a branch from the temporo-malar, Fig. 3, 4, and sends a palpebral twig to the upper eyelid, Plate 10, Fig. 3.

The *nasal*, Fig. 5, 7, Fig. 2, 2, enters the orbit between the heads of the external rectus, and between the two divisions of the third nerve. It crosses the optic nerve, and passes forward to the anterior internal orbital canal. It then takes the same course as the anterior ethmoidal artery—i.e., along the cribriform plate to a foramen at the fore-part, through which it passes into the nose, on the inner side of the nasal bone, to the interval between it and the lateral cartilage, and through this interval to the skin of the nose, where it is joined by a filament from the facial. In the orbit it supplies the *long root to the lenticular ganglion*, the long *ciliary branches*, Fig. 5, 9, and the *infra-trochlear branch*, Fig. 5, 8. The ciliary branches are internal to the optic nerve, and pierce the sclerotic; the infra-trochlear passes forwards beneath the pulley, is joined by a twig from the supra-trochlear, and supplies the skin of the inner side of the nose and upper eyelid.

In the nose it gives a branch to the septum (*see wood-*

cut, p. 97), and others to the anterior part of the outer wall.

The *lenticular* or *ciliary ganglion*, Fig. 5, 14, is a small reddish body at the back of the orbit, situated outside the optic nerve between that and the external rectus. It is joined behind by the long root derived from the nasal nerve, and a twig from the cavernous plexus, and below by the short root from the branch of the third nerve to the inferior oblique. From the front of the ganglion pass the short ciliary nerves, ten or twelve in number, which pierce the sclerotic at the posterior part; they communicate with the long ciliary from the nasal.

The *sixth nerve*, Fig. 4, 10, Fig. 5, 13, after piercing the dura mater, lies either in a groove at the apex of the petrous portion of the temporal bone, or over the junction between this bone and the sphenoid, where it is often crossed by a small fibrous band, as in Fig. 4. It crosses the carotid artery and the floor of the cavernous sinus, and enters the orbit between the heads of the external rectus, above the ophthalmic vein, but below the third nerve. It then enters the external rectus on its ocular surface.

Paralysis of any of the nerves supplying the muscles of the eye produces a squint in one direction or the other. Thus, if the sixth nerve be interfered with, the external rectus is paralysed, and internal strabismus is the result. If the third nerve suffer, the external rectus is unopposed and external strabismus occurs, at the same time ptosis, or dropping of the upper lid, takes place, as the levator palpebræ superioris receives its nerve from the same source; and dilatation of the pupil, as a result of the loss of power in those fibres of the iris which cause its contraction, passing to it through the short root of the lenticular ganglion and the ciliary nerves. These forms of strabismus are not to be confused with those which result from spasmodic contraction of one or more of the ocular muscles. A paralysis of the fourth nerve cannot be distin-

guished by any resulting displacement of the eye. The function of the fifth nerve being purely sensory, any impairment of its functions will result either in trophic or sensory changes in the eye or in the parts to which its cutaneous branches are distributed.

The large amount of fat which fills the interstices amongst the structures which occupy the orbit, gives them support and allows of their free movement. Its absorption gives the sunken appearance to the eye which occurs during emaciation; its undue accumulation is one of the causes of protrusion of the eyeball, or exophthalmos, though it must be remembered that this symptom may depend upon the existence of a tumour in the orbit, or from other less understood causes, as in the case of exophthalmic goitre. Hæmorrhage into the orbit is one of the important diagnostic symptoms following a fracture of the skull involving part of its wall; this is distinguished from the cutaneous ecchymosis of a black eye by its fainter purplish colour, and often by its late appearance after the injury; such a hæmorrhage generally passes forwards under the conjunctiva.

PLATE 13.

FIG. 1.

THIS dissection exhibits the back view of the pharynx, together with the parts in relation with its sides. In order to obtain it, the first steps of the dissection are those which have been detailed in the description of Plate 6, but to expose the bifurcation of the trachea, and the arch of the aorta as has been done in this drawing, it would be necessary to extend the dissection down to the level of the fourth dorsal vertebra. By doing so, the rhomboideus major would have been exposed after the removal of the trapezius, and beneath it the origin of the serratus posticus superior. Deeper still the upper parts of the longissimus dorsi and accessorius muscle would make their appearance. After the dissection had been carried to the depth shown on the left side of Plate 6, Fig. 2, and the structures then exposed, as well as the subjacent multifidus spinæ had been removed, it would have been necessary to divide the origins of the scalene muscles from the transverse processes, to cut through the first four ribs with their intervening muscles, vessels, and nerves at the limits of the incisions, to divide the spinal column, and its contents at the interval between the fourth and fifth dorsal vertebræ, and then to turn it up with the attached longus colli, and recti capitis antici, dividing at the same time the cervical nerves at their exit from between the transverse processes, as well as the vertebral artery and vein. The very difficult task would then follow of separating the atlas from the occipital bone, while at the same time the recti capitis major, minor, and lateralis were cut near the skull, and the spinal cord was divided as it passed into the medulla.

On the left side the anterior scalenus, and the cut ends of the cervical nerves were completely cleared away, their branches of communication with the other nerves of the neck, as well as the ascending cutaneous and sterno-mastoid (muscular) branches being divided, and then the structures shown in the drawing were exposed by the removal of fat and cellular tissue. It will be remembered that a considerable portion of pleura which is not shown in the drawing would be seen at each side in contact with the aorta and the trachea.

On the right side the following structures were removed one after the other:—two chains of lymphatic glands, and arteries to them from the occipital, ascending pharyngeal, and inferior thyroid; the spinal accessory nerve; the common and internal carotid arteries, and internal jugular vein with their sheath; the sympathetic and vagus nerves and their branches; the hypoglossal and the descendens noni; then a part of the occipital and ascending pharyngeal arteries, and the external carotid with the commencement of the facial and superior thyroid; the glosso-pharyngeal nerve; the posterior belly of the digastric, and the stylo-hyoid with the nerves entering them. A thin fascia was then taken from the internal pterygoid muscle, and the denser fascia and vessels, and nerves from the surface of the constrictors. At the lower part of the dissection the objects exposed were cleared by the removal of the cellular tissue investing them, and lastly the sterno-mastoid was pulled outwards in order to display more fully the parts which had been laid bare.

The lymphatic glands throughout this subject were larger than natural; they have been drawn very nearly as they actually appeared. The attention of the reader is particularly directed to the appearance which the *parotid gland*, ||, and the *submaxillary gland*, =, present when viewed from this aspect, to the view which this dissection gives of the commencement of the *facial nerve*, 1, and of the branches which arise from it, and of the direction assumed by the second part

of the arch of the aorta. He will also notice that the direction of the hyoid bone is not nearly horizontal, so that the part here seen is the inferior aspect of the great cornu, above (here apparently in front) of which is passing the *hypoglossal nerve* and *lingual artery*. In showing the back view of the pharynx, the skull is generally sawn in front of the foramen magnum as in Fig. 2; it was thought that by leaving it untouched a better idea is obtained of the actual relation of the parts.

The *thoracic duct*, **, passes underneath the arch of the aorta resting on the œsophagus; as it ascends it lies first between the latter and the first part of the subclavian, and afterwards slightly in front of this vessel, though still on the œsophagus; it then passes outwards from behind the common carotid artery, crossing over the vertebral to end as shown in Plate 1, Fig. 2, (p. 7).*

A considerable piece of the *parotid gland*, ||, is shown beneath the sterno-mastoid; and below the internal pterygoid muscle is the inner surface of the *submaxillary gland*, =. The reader will notice the manner in which the lobes of the *thyroid body*, +, +, clasp the lower part of the pharynx and the upper part of the œsophagus, and rest against the common carotid arteries.

MUSCLES.

All the muscles here shown, except those of the pharynx, have been more fully displayed elsewhere. These have been seen in part in some of the front and side views of the neck, and in Plate 14 they are completely shown in profile.

The *constrictors of the pharynx* are three in number—*superior*, A, *middle*, B, and *inferior*, C. The origins of these muscles are narrow as compared with their insertions, and they

* The duct in this preparation kept close to the subclavian and passed behind the vertebral which rose from the arch of the aorta. I must confess to having altered it slightly in the drawing, so as to place it in the position usually assigned to it.

are so arranged that the lower overlaps the middle, and the middle the upper, and in consequence the lower alone is completely exposed in such a dissection as the present.

The *inferior constrictor*, arises, Plate 14, Fig. 1, C, from the side of the cricoid cartilage behind the crico-thyroid muscle, often from a curved ligamentous arch over the outer part of this muscle, and from the oblique line on the thyroid cartilage and part of the surface behind it. The highest fibres pass upwards over the middle constrictor, and reach as far as the upper part of the pharynx, becoming at last nearly vertical. The lowest fibres arch downwards and gradually disappear between the converging longitudinal fibres of the œsophagus, being apparently continuous with the transverse fibres of this tube. The parts shown on removing the muscle are exhibited in woodcut, p. 133—viz., the posterior part and cornua of the thyroid cartilage, and parts of the middle constrictor, the stylo-pharyngeus and palato-pharyngeus, and the lower part of the mucous membrane of the pharynx; the superior and inferior laryngeal nerves are found beneath its upper and lower borders respectively.

The *middle constrictor* is seen completely in the woodcut, p. 133. It arises, Plate 14, Fig. 1, B, from the great and small cornua of the hyoid bone, and the termination of the stylo-hyoid ligament. The upper fibres pass nearly vertically upwards and reach almost to the top of the pharynx, the lower fibres curve downwards and appear to be continuous with the lower part of the palato-pharyngeus. The woodcut, p. 134, shows the structures which lie beneath it—viz., parts of the superior constrictor, the stylo-pharyngeus and palato-pharyngeus. In this case a considerable slip joined this muscle to the stylo-hyoid.

A small portion only of the *superior constrictor* is shown in the plate. It is completely exposed in the woodcut, p. 134. It arises from the lower part of the posterior border of the internal pterygoid plate, from the pterygo-maxillary ligament,

from the upper part of the mylo-hyoid ridge on the inferior maxilla, and from the side of the tongue (*pharyngeo-glossus*),



- A. Superior constrictor.
- B. Middle constrictor.
- C, C. Inferior constrictor (reflected).
- D, D, D. Stylo-pharyngeus.
- E. Palato-pharyngeus.
- F. Thyro-hyoid.
- G. Stylo-glossus.
- H. Upper fibres of oesophagus.

K. Stylo-hyoid.

- a, a. Condyles of occipital bone.
- b, b. Styloid processes.
- c. Occipital bone.
- d. Hyoid bone.
- e. Thyroid cartilage.
- f. Cartilago triticea.

and the mucous membrane of the mouth. The fibres do not diverge so greatly as those of the other two muscles; the upper ascend almost or quite as far as the pharyngeal spine, while the lower arch slightly downwards over the palato-pharyngeus. Its origin from the pterygo-maxillary ligament corresponds with that of the buccinator upon the opposite side, it rests upon the pharyngeal aponeurosis, the palato-pharyngeus, and the tonsil. The levator palati, the ascending palatine branch of the facial, and the palatine branch of the ascending pharyngeal pass to the palate over its upper border.

The points of attachment of the muscles which arise from the styloid process are as follows :—The *stylo-glossus*, G, arises from the tip of the styloid process, close to the attachment of the *stylo-hyoid ligament*, $\times \times$; the *stylo-pharyngeus*, F, from the inner side of the base, and the *stylo-hyoid*, H, from the outer or posterior aspect near the base. On comparing this with Plate 14, Fig. 1, and remembering that the tip of the styloid process projects further inwards than the carotid arteries, while the process itself lies between them, it will be



- A. Superior constrictor.
- A'. Pharyngeo-glossus.
- B. Middle constrictor (reflected).
- C. Inferior constrictor (reflected).
- D. Stylo-pharyngeus.
- E. Palato-pharyngeus.
- F. Stylo-glossus.
- G. Hyo-glossus.
- H. Mylo-hyoid.
- K. Buccinator.
- L. Stylohyoid (cut).
- M. Levator palati.
- N. Tensor palati.

- a, a. Condyles of occipital bone.
- b. Styloid process.
- c. Occipital bone.
- d. Pharyngeal aponeurosis.
- e. Gustatory nerve.
- f. Inferior maxilla.
- g. Pterygo-maxillary ligament.
- h. Tip of sublingual gland.
- i. Submaxillary gland.
- k. Facial artery.
- l. Lingual artery.
- m. Hyoid bone.
- n. Thyroid cartilage.
- o. Cartilago-triticea.

understood that the stylo-hyoid is superficial to both vessels and the stylo-pharyngeus passes between them, though the stylo-glossus has no relation to either.

The aponeurotic structures in connexion with the pharynx are external and internal; the former is a layer of connective tissue, ††, covering the constrictors, and closely connected with the prevertebral fascia, which is continuous below with the sheath of the large vessels and the deeper layers of the cervical fascia, and above with the fascia which covers the buccinator. The internal fascia, the *pharyngeal aponeurosis*, †, is attached above in the middle line to the pharyngeal spine on the occipital bone. Traced outwards its attachment will be marked by a curved line whose convexity is forwards, which passes across the fibro-cartilage occupying the foramen lacerum medium with which the aponeurosis is intimately connected. Then it blends with a strong sheath which encases the levator palati, and passing forward is attached to the Eustachian tube and the internal pterygoid plate. This fascia may be traced down as far as the level of the hyoid bone. It is strongest at the upper and posterior part—*i.e.*, above the level of the superior constrictor, and it is strengthened by fibrous bands in the middle line and at the extreme outer part. The curve in the line of attachment of the pharyngeal aponeurosis gives rise to two pouches at the sides of the highest part of the pharynx. At the lower part of the pharynx is an elastic membrane connected in front with the hyoid bone and the larynx, and the thyro-hyoid membrane.

ARTERIES.

It will be noticed that the bulging which indicates the point of division of the *common carotid artery* is in this case above the level of the upper border of the thyroid cartilage. The *occipital artery* gave the small stylo-mastoid branch which usually comes from the posterior auricular, and passed, as not unfrequently happens when the position of this vessel is low, over instead of beneath the trachelo-mastoid.

The *ascending pharyngeal*, *k*, (*vide* p. 78), is shown in its upper part as well as the branches which it sends to the muscles of the pharynx. These muscles are supplied by a chain of anastomoses between this artery above, and the superior and inferior thyroids below.

VEINS.

The description of the *internal* and *external jugular* veins, the only ones here drawn, will be found at p. 1. The reader will again observe the different relation borne by the internal jugular to the carotid artery on the two sides of the neck.

NERVES.

The *vagus*, 5, is shown better than has been the case in the preceding Plates. From the ganglion of the trunk is a branch of communication with the upper ganglion of the sympathetic, and round its posterior aspect the *hypoglossal nerve*, 6, is seen to wind. The *superior*, 9, and *inferior*, 12, *laryngeal* nerves appear at the sides of the pharynx above and below; the inferior on the right side winding round the subclavian artery. The cord of the sympathetic uniting the *upper ganglion*, 8, with the *middle*, 11, lies behind the sheath of the vessels.

The *pharyngeal plexus* is situated at the back of the middle constrictor. It consists of branches derived from the *glossopharyngeal*, the *pharyngeal* and *superior laryngeal* branches of the *vagus*, and the sympathetic. It supplies branches to the constrictors of the pharynx. There are separate branches from the external and from the inferior laryngeal to the inferior constrictor.

The *spinal accessory*, 7, is again passing in front of the vein, and perforating a small portion only of the sterno-mastoid.

Attention is directed to the good view obtainable in a dissection of this kind of the *facial nerve*, 1, at its exit from the stylo-mastoid foramen. It gives off in this position three branches:—the *posterior auricular*, 2, outwards; and downwards

a short branch, 3, to the posterior belly of the digastric, which communicates with the glosso-pharyngeal, and a longer and more slender one to the stylo-hyoid, 4, which communicates with the sympathetic on the external carotid.

FIG. 2.

This view was obtained from the last dissection by slitting up the posterior wall of the pharynx, and removing the mucous membrane from everything which is shown in the left half of the preparation, with the exception of the tongue and the epiglottis. It shows the muscles of the palate, and some of those of the larynx.

On the right side are seen the objects which appear on opening the pharynx from behind before they are dissected—viz., above, the *posterior nares* separated by the *septum nasi*, β , and behind them the *Eustachian tube*, a ; below these is the *soft palate* arching over the back of the mouth, and terminating in the *anterior* and *posterior pillars of the fauces*, between which is the tonsil (Plate 14, Fig. 2., θ , (here removed). Lower still is the *epiglottis*, δ , guarding the upper aperture of the larynx, and connected with the *arytænoid cartilages*, ϵ , by the *arytæno-epiglottidean folds*. On each side of these, and at a lower level, is a little pouch not unimportant to the surgeon as a part where a bougie is liable to be caught if it be not kept accurately in the middle line, and in the middle line is the flat posterior aspect of the *cricoid cartilage*, ζ , opposite the lower border of which the œsophagus begins.

On removing the mucous membrane, besides the muscles the posterior aspect of the *cartilage of the Eustachian tube*, a , and the inner aspect of the *thyroid cartilage*, η , are laid bare.

MUSCLES.

The *palato-pharyngeus*, C, C' , consists of two layers in the soft palate. Of these the upper, C , forms the most superficial

layer of the muscular part of the velum, and the lower, C', lies between the tensor and levator palati. The fibres after having been joined by those of the salpingo-pharyngeus, pass downwards in the posterior pillar of the fauces, and then spread out in a fan-shape. The inner or upper fibres are almost horizontal, and pass to the middle line beneath the middle constrictor; the lower or outer fibres blend with those of the stylo-pharyngeus (*see* woodcut, p. 134), and end upon the back of the pharynx at the level of the inferior cornu of the thyroid cartilage, to which it is said to be attached. A few passed down in the preparation, and in that for Plate 14, Fig. 2, to join the aryteno-epiglottideus muscle.

The *salpingo-pharyngeus*, B, which was here abnormally large, arises usually by a small tendon near the end of the cartilage of the Eustachian tube, and passes vertically downwards to end by joining the palato-pharyngeus.

The *stylo-pharyngeus*, F, arises from the inner part of the styloid process near its base and enters the wall of the pharynx between the contiguous borders of the superior and middle constrictors after the glosso-pharyngeal nerve has wound round it. It spreads out now like the palato-pharyngeus, but external to it. Its internal fibres end on the back of the pharynx, where they blend with the palato-pharyngeus (*see* woodcuts), while its outer fibres are attached to the upper and posterior borders of the thyroid cartilage, as shown in the Plate and also in the woodcuts.

The *levator palati*, D, Fig. 1, E, arises from the under surface of the petrous portion of the temporal bone and from the internal and posterior aspect of the cartilage of the Eustachian tube. It enters the pharynx above the superior constrictor, and ends in the soft palate by spreading out between the superficial and deep fibres of the palato-pharyngeus.

The *tensor palati*, Fig. 1, D, better seen in Plate 14, Figs. 1 and 2, arises from the scaphoid fossa on the pterygoid process, the external and anterior surface of the cartilage of the Eusta-

chian tube and the spine of the sphenoid. Its belly has on one side the levator palati and the internal pterygoid plate, and on the other the internal pterygoid muscle; it ends in a tendon which hooks round the hamular process, and then takes a horizontal direction in the soft palate, spreading out beneath the other muscles into a thin aponeurosis with diverging fibres, some of which pass inwards and forwards, to be attached to a ridge on the under surface of the palatal process of the palate bone.

The *azygos uvulae*, E, is a small longitudinal band of fibres on each side of the middle line, superficial to all the other muscles except the superficial fibres of the palato-pharyngeus. It is attached in front to the posterior nasal spine, and ends at the root of the uvula.

The *palato-glossus*, Plate 14, Fig. 2, F, begins above on the under surface of the soft palate, and after passing down in the anterior pillar of the fauces ends below at the side of the tongue by blending with the hyo- and stylo-glossus muscles, and sends a few fibres almost transversely across the dorsum. It is the lowest muscle in the velum.

The description of the muscles of the larynx shown in the drawing will be given with that of the following Plate.

The aponeurosis of the palate is principally derived from the expansion of the tensor palati, but another thin layer of fascia has been described at a deeper level, as well as an indefinite fibrous septum corresponding to the median raphe, which is apparent on the anterior and posterior aspects, and which indicates the original division of the soft palate into separate halves.

The following is approximately the action of the muscles under consideration. The superior constrictor contracts the upper or nasal portion of the pharynx, and helps the muscles of the palate in separating this upper from the lower or guttural portion. The middle and inferior constrictors contract round the bolus of food which has been handed into their

grasp, and pass it on to the œsophagus. The stylo-pharyngeus raises the pharynx and the thyroid cartilage. The palato-pharyngeus has to some extent the same action, but its principal duty is to bring the posterior pillars of the fauces together, or almost into apposition (the uvula usually lies between). The salpingo-pharyngeus assists the palato-pharyngeus in raising the pharynx. The levator palati raises the soft palate, and probably from the pressure of its belly when contracted against the orifice of the Eustachian tube it helps to close it (Lushka, "Der Schlundkopf des Menschen," p. 47). The tensor palati, as its name implies, tightens the velum, and also draws outwards, and so opens the orifice of the Eustachian tube. The azygos uvulæ shortens the uvula. The palato-glossus presses the anterior pillar of the fauces against the back of the tongue, and draws upwards the posterior part of the side of that organ.

During the act of deglutition after the food has been masticated by means of the teeth through the influence of the muscles of mastication, the tongue is shortened by its longitudinal fibres, and drawn upwards and backwards by means of the stylo-glossi muscles, while the palato-glossi forcing the anterior pillars against its dorsum separate the pharynx from the cavity of the mouth. At the same time the nasal part of the pharynx is shut off by the contraction of the superior constrictors, the palato-pharyngei, and the levatores palati, while the hyoid bone and larynx are raised by the action of the muscles attached to them. This raising of the thyroid cartilage under the hyoid bone, and of both against the already retracted tongue, presses the epiglottis as a whole backwards. It is afterwards depressed over the upper aperture of the larynx, probably in part by the action of the feeble aryæno-epiglottideus muscle, so that by the time the middle constrictor has handed the mouthful of food down to the inferior constrictor, the entrance to the larynx is completely protected. But a further protection to the opening

of the air-tube is afforded by the approximation of the arytaenoid cartilages to the tubercle of the epiglottis, and by the approximation or closure of the apertures between both the true and false vocal cords. (Czemak, "On the Practical Uses of the Laryngoscope." New Sydenham Soc. 1861, vol. xi.)

ARTERIES.

The arteries supplying the soft palate, are the *palatine*, *a*, derived from the facial and the *ascending pharyngeal*, which enter it over the upper border of the superior constrictor, and the *descending palatine* branches from the internal maxillary.

FIG. 3

Shows the appearance presented, if the larynx and tongue be removed from the body in the usual way, and a view be taken from above. The same appearance is obtained when the throat is examined with the laryngoscope, although the image is then of course inverted. It will be again referred to in describing the following Plate.

The surface of the tongue is marked along the centre by a *median raphe*, which ends near the posterior part in the *foramen cæcum*, 12, in this instance occupied by a large papilla circumvallata. Passing forwards and outwards from this in two rows are the *papillæ circumvallatæ*, 13, seven to twelve in number. Behind the foramen cæcum the tongue is almost free from papillæ, and presents a soft shining mucous membrane, marked by many slight elevations, indicating the presence of mucous glands and follicular crypts, analogous in structure to that of the tonsils. From this part, pass backwards the three *glosso-epiglottidean folds*, two *lateral*, 3, and one *central* or *frænum*, 4. The anterior part of the dorsum of the tongue is rough, and occupied by papillæ of two descriptions, the smallest, *papillæ conicæ* and *papillæ filiformes*,

covering the whole of the surface, and arranged in irregular rows diverging forwards and outwards from the middle line of the tongue. The larger ones, *papillæ fungiformes*, 14, are dotted irregularly over the surface, but are more plentiful near the apex and tip.

As age advances, and in dyspeptic people, the tongue is often marked by irregular transverse and longitudinal rugæ, sometimes of very considerable depth.

The *tonsils* are two collections of adenoid tissue, situated between the anterior and posterior pillars of the fauces, covered externally by the superior constrictor, and corresponding in position almost with the angle of the jaw. They are very close to the internal carotid artery, a point to be remembered in removing these glands. If the knife be kept within the line of the molar teeth there is no fear of injuring the vessel, and a little traction towards the middle line will increase the distance between the gland and the artery. They are plentifully supplied with blood from the facial, ascending pharyngeal, descending palatine, and dorsal lingual arteries, from which troublesome hæmorrhage may arise after their removal. The surface of the tonsil is marked by numerous pits, which when the tonsil is enlarged may easily be mistaken for ulcers. Great enlargement of the tonsils is sometimes a serious impediment to respiration.

Not many points of surgical or medical interest are suggested by this Plate, beyond those which have been before discussed in the description of the nose. It will be remembered that the finger introduced into the mouth can explore the posterior nares, the epiglottis, and the upper aperture of the larynx, in search of tumours or foreign bodies. The width of the lower end of the pharynx, and the smallness of the entrance into the œsophagus, suggest the advisability of keeping a bougie accurately in the middle line. The necessity for this precaution is greatly increased in cases of stricture affecting the upper end of the œsophagus. If the instrument be not kept

well against the posterior wall of the pharynx, the point of it, if a small one, may enter the larynx, an accident which might prove fatal, if an attempt were being made to introduce food into the gullet beyond the seat of stricture.

The levator palati and azygos uvulæ are supplied by the facial nerve by means of Meckel's ganglion. If the nerve of one side be paralysed, the palate on that side will drop, while the uvula will be drawn to the opposite side. This will serve as a guide to the diagnosis of a central from a peripheral lesion, as the great superficial petrosal leaves the facial in the temporal bone.

The tongue is *pushed* out of the mouth, but *drawn* into it. Paralysis of one hypoglossal will accordingly cause it to be protruded to the side of the lesion, but to be retracted to the sound side.

PLATE 14.

FIG. 1.

THIS drawing represents a side view of the pharynx and larynx in their actual relation to the parts in front of and behind them. It also is intended to show the buccinator and orbicularis oris.

It was prepared in the following manner. The head after having been removed was imbedded in plaster of Paris, so that the natural curves might be preserved, and an incision was carried horizontally from the occipital protuberance to the nostril, curving it upwards slightly at the ear, and along the zygoma. From the ends of this vertical and mesial incisions were made to the lower part of the neck. The first part of the dissection consisted in removing the structures in the lower part of the face, the directions for which may be obtained by studying Plate 7. In order to show the orbicularis completely, the elevators of the upper lip, and the depressors of the angle of the mouth and lower lip, were taken away. The sterno-mastoid was then removed, and the structures beneath it and in the anterior triangle were one by one removed. The guides to this part of the dissection may be seen in Plates 1 and 2. Next, the parotid gland was picked away. Then the lower jaw was sawn through vertically in front of the ramus, and the pterygoid muscles and the other structures in the pterygo-maxillary region were removed, including nearly the whole of the external pterygoid plate (compare Plate 9, Figs. 1 and 2). The stylo-hyoid muscle was taken away, and the origin of the hyo-glossus, and also the remains of both carotid arteries, the internal jugular vein, and the deep nerves at the upper part of the neck, the gloss

pharyngeal, superior laryngeal, and external laryngeal being cut short and the ends left in situ. Lastly the spinal column and the structures behind it were divided by a vertical and longitudinal incision which passed almost in the middle line, and the right half was removed, together with the attachment to the spine of those muscles which remained undissected.

It was found impossible in making the drawing to represent thoroughly the difference in level between the parts shown in section and those in front of the spinal column, but this difference must be borne in mind. Two points must strike the reader in looking at the drawing—viz. in the first place, the large amount of the neck from behind forwards which is occupied by the spinal column and the structures behind it, and in the second place, the small proportion of the space in front of the spine which is devoted to the œsophagus and pharynx. The method of displaying the pharynx employed in the dissecting room does not indeed give any notion of the collapsed condition it presents in the living body. The œsophagus is only seen on the right side as far as the level of the first dorsal vertebra or thereabouts, as it is inclined to the left side of the neck soon after its commencement. The stylo-pharyngeus, though not cut away, was not seen in the position from which the preparation was viewed.

MUSCLES.

The description of the muscles of the pharynx and palate has been given with that of Plate 13. This drawing and Fig. 2 show how wide the *tensor*, D, and *levator palati*, E, appear in full side view. The origins of the *constrictors* are better shown in a side view than in one taken from behind. The description of the *buccinator*, F, has been given at p. 72; the relation which its origin bears to that of the *superior constrictor*, A, is now apparent.

The *orbicularis oris*, G, is an orbicular muscle surrounding the mouth, as the *orbicularis palpebrarum* surrounds the ocular

slit, and divided like it into two parts, an internal, the fibres of which pass continuously round in the substance of the lips without any attachment to bone, and an external, which is attached above to the septum nasi and to the upper jaw over the canine tooth outside the origin of the depressor alæ nasi, and below to a similar point on the lower jaw outside the origin of the levator menti. It blends at the outer part with the fibres of the muscles converging towards the mouth, the buccinator, the elevators and depressors of the angle of the mouth and lips, and the common elevator of the lip and wing of the nose.

The whole muscle closes the mouth both vertically and transversely, but if the buccinator be acting at the same time the mouth is elongated. The outer fibres press the cheeks against the teeth and evert the lips, while the inner ones invert the red border of the lips.

The *levator menti*, M, (*levator labii inferioris*) arises near the middle line from the front of the lower jawbone, and is inserted into the skin of the chin between the depressor muscles of the lower lip. Its action is to dimple the skin in this situation.

The *levator anguli oris*, the *compressor narum*, and the *depressor alæ nasi* have been described at p. 101.

FIGS. 2, 3, 4, AND 5.

In making this dissection from the last, the hyo-glossus, previously divided, was stitched together, the three constrictors were removed, and the stylo-pharyngeus cut short near the point where it enters the wall of the pharynx and the stylo-hyoid completely taken away; the side of the pharynx was opened by a vertical incision; the crico-thyroid muscle and nearly half the thyroid cartilage were taken away and the structures beneath the latter were cleaned. Lastly, the remainder of the

right half of the lower jaw was removed with the orbicularis and buccinator muscles, the pterygo-maxillary ligament and the submaxillary and sublingual glands; and the tonsil, the palato-glossus and the outer part of the tongue were defined.

Figs. 3, 4, and 5 were prepared from a larynx which had been taken from the body in the usual manner. In Fig. 3 a vertical section was made through the isthmus of the thyroid gland, the front of the thyroid and cricoid cartilages, crico-thyroid and thyro-hyoid membranes, and the epiglottis with the fat in front of it. The divided parts were then separated as widely as possible. Figs. 4 and 5 was prepared by dividing the larynx and tongue vertically. The incision did not pass exactly in the middle line so that scarcely any of the epiglottis appears in Fig. 4 while nearly the whole is shown in Fig. 5.

Fig. 2 shows the *palato-pharyngeus*, C, from the outer aspect, with its larger portion passing between the elevator and tensor of the palate, while its smaller part is superficial to the former. It also shows the tonsil from the outer aspect, and the manner in which the palato-glossus and stylo-glossus blend with the hyo-glossus at the posterior part of the side of the tongue. Fig. 3 represents the appearances which are seen in performing the operation of thyrotomy.

Without giving a detailed description of the cartilages of the larynx it will be necessary to mention the sort of movements which can take place between them. That between the thyroid and cricoid is one of rotation round a horizontal axis drawn through the tips of the inferior cornua. This line is much below the level of the true vocal cord, and consequently any rotation downwards of the thyroid will also separate the attachments of the cord, or, in other words, will tighten it, while any rotation upwards will have a contrary effect. Between the arytaenoids and the cricoid the movement is principally rotatory round a vertical axis, but a certain amount of gliding movement is also possible, both in the antero-posterior

and lateral sense. Now as the vocal cord is attached to the anterior angle of the base of the arytaenoid cartilage, any rotation out of this angle, or, what is the same thing, any rotation backwards of the outer angle will cause a widening of the posterior part of the rima glottidis; while rotation in the opposite direction will have a directly opposite result. The effect of the lateral movement would be principally to widen or diminish the interval between the apices of these cartilages, their bases being already almost in opposition; and that of the antero-posterior gliding movement to approximate or remove the arytaenoids to or from the thyroid cartilage.

The articulations in which these movements occur—i.e. between the inferior cornua of the thyroid and the cricoid, and between the posterior part of the upper border of the cricoid and the arytaenoids are capsular joints with synovial membranes, the latter being very loose.

The *crico-thyroid membrane*, Fig. 5, ϵ , is a strong membrane consisting of white fibrous and elastic tissue, attached below to the upper border of the cricoid cartilage, and above, in front to the lower border and inner surface of the thyroid cartilage as high up as midway along the central portion, while laterally it presents a free edge which ends behind by being attached to the anterior angle and inner border of the base of the arytaenoid cartilage. The surfaces of the membrane look, one obliquely inwards and slightly downwards, and the other outwards and slightly upwards, and they are in contact respectively with the mucous membrane of the larynx and the crico-thyroid and thyro-arytaenoid muscles. Its free edge consists of yellow elastic tissue, and forms the true vocal cord. The central portion of the ligament is usually described as distinct.

The *thyro-hyoid membrane*, Fig. 5, η , is a strong membrane passing from the upper border of the thyroid cartilage to be attached to the upper part of the posterior surface of the hyoid bone. Its upper attachment allows of the thyro—

cartilage being drawn up completely behind the hyoid bone, and this is made more easy by the presence of a bursa, often of large size, between the opposed surfaces of the membrane and the bone. The parts of this ligament which unite the great cornua of the thyroid cartilage and the hyoid bone are stronger than the rest of the membrane, and are called in consequence the thyro-hyoid ligaments; they contain a small ovoidal mass of cartilage, the *cartilago triticea* (see woodcuts, pp. 133, 134).

The prolonged narrow part of the *epiglottis*, Fig. 5, θ , is fixed to the midpoint of the posterior or inner surface of the thyroid cartilage. Above its point of attachment it projects backwards, forming the *tubercle*, Plate 13, Fig. 3, 2. Between it and the hyoid bone is a considerable mass of fat, called sometimes the epiglottidean gland, Fig. 3, β , Figs. 4 and 5, κ .

The interior of the larynx is covered by mucous membrane, which presents certain folds and depressions. After investing closely the true vocal cords, Fig. 4, ζ , it is marked by a long and deep horizontal groove, the *ventricle of the larynx*, Figs. 3 and 4, θ , the lower border of which is the true, and the upper the false, vocal cord. This depression is wider and deeper behind than in front, and is marked by one or two folds, beneath one of which is an opening leading into a small pouch lined by mucous membrane, called the *sacculus laryngis*, which runs upwards and backwards for about half an inch—i.e., as far as the upper border of the thyroid cartilage in the direction marked η , in Fig. 4. A fold on each side passes from the ary-tænoid cartilage to the epiglottis:—the *arytæno-epiglottidean fold*, in each of which is a minute cartilaginous body, the cuneiform cartilage or *cartilage of Wrisberg*, while quite at its posterior part—i.e., over the apex of the ary-tænoid cartilage—is the somewhat larger *cartilage of Santorini* or *corniculum laryngis*. In front of the epiglottis are the three glosso-epiglottidean folds previously described.

The mucous membrane is closely adherent and thin over the epiglottis, and still more adherent over the vocal cords; but about the arytaeno-epiglottidean fold there is a layer of sub-jacent loose areolar tissue, giving it a pulpy consistence, and liable to swell under certain conditions, giving rise to what is known as œdema glottidis. The epithelium is ciliated below the vocal cords and for a certain distance above them—*i.e.* for a line or two at the posterior part, and in front nearly as high as the top of the epiglottis. The rest of the epithelium, as well as that covering the vocal cords themselves, is of the squamous variety.

The space between the true vocal cords is called the *rima glottidis*; its appearance as viewed from above is shown in Plate 13, Fig. 3, where it will be seen to be situated well within the interval between the false vocal cords (Plate 13, Fig. 3, 8). The rima is bounded behind by the interval between the two arytaenoids, and in front by the thyroid cartilage; and laterally by the true vocal cords and the inner sides of the bases of the arytaenoid cartilages. During contraction the aperture is a mere slit; when moderately dilated, as seen after death, it is of a spindle shape; and when widely dilated, it forms a triangle with the apex forwards. The upper aperture of the larynx, on the other hand, or the interval between the arytaeno-epiglottidean folds, is of a wide triangular shape, the base of the triangle being directed forwards (Plate 13, Fig. 3). It will not be forgotten that in examining a patient with the laryngoscope, the image, and consequently the apparent direction of these two triangles, is inverted.

MUSCLES.

Crico-thyroid, Fig. 1, R, arises from anterior part of the outer side of the cricoid cartilage, and is inserted into the inferior cornu, the lower border and internal surface of the thyroid cartilage, some of its fibres ending in the crico-thyroid membrane. It is generally continuous in part with the inferior

constrictor. Its fibres are directed upwards and backwards ; it consequently rotates the thyroid cartilage downwards and forwards, and so tightens the vocal cords.

The *thyro-arytænoideus*, Fig. 2, L, Fig. 5, D, arises from the back of the mesial portion of the thyroid cartilage, below the middle, and from the crico-thyroid membrane. Its fibres run in two directions. The strongest pass directly backwards, to be attached to the anterior angle of the base and outer surface of the arytenoid cartilage, and consequently act, to some extent, by approximating this cartilage to the thyroid and relaxing the vocal cord. The other fibres ascend in part obliquely to the outer surface of the arytenoid cartilage, and in part pass upwards towards the epiglottis, and blend with the aryteno-epiglottideus muscle, the action of which they assist. The fibres of this muscle are generally continuous with the transverse fibres of the arytenoideus, and the two muscles, together with the crico-arytenoideus lateralis, form accordingly a sort of sphincter to the rima glottidis, which, after the vocal cords have been tightened by the crico-thyroids, brings them together, or, in other words, into the vocalising position.

The *crico-arytænoideus posticus*, Plate 13, Fig. 2, H, arises from the depression at the back of the cricoid cartilage, and its fibres pass upwards and outwards to be inserted into the outer angle of the base of the arytenoid cartilage. It accordingly pulls this angle back, and, as a result, the anterior angle of the base is separated from its fellow (p. 148), and the base of the rima is widened.

The *crico-arytænoideus lateralis*, Fig. 2, N, arises from the upper margin of the cricoid at the side, and is inserted into the outer side and outer angle of the base of the arytenoid cartilage ; it therefore opposes the action of the crico-arytænoideus posticus, and diminishes the width of the rima glottidis.

The *arytænoideus*, Fig. 2, M, Plate 13, Fig 2, K, consists of two sets of fibres. A deep set which are transverse in direction, and are attached to the hollow posterior surfaces of

the arytaenoid cartilages; and a superficial set, Fig. 2, K, which cross one another in the middle line like the parts of a letter X, and are continued up in the arytaeno-epiglottidean folds, where they are joined by the ascending fibres of the thyro-arytaenoideus, to the epiglottis. These superficial fibres are very pale and weak in the arytaeno-epiglottidean folds, and are sometimes called the *depressor of the epiglottis*. They act feebly in drawing down the epiglottis, while the deeper and stronger fibres approximate the apices of the arytaenoid cartilages.

It has been shown by Lister (Holmes, "A System of Surgery," vol. v. p. 492, 2nd ed.) that the entrance to the larynx may be closed in four different ways; first, the folding back of the epiglottis as occurs during the act of swallowing;* second, the approximation of the sides of the superior orifice, the epiglottis being directed forwards, but its sides folded back, and in contact with one another, while the arytaeno-epiglottidean folds are also in apposition (this, Lister says, takes place during retching, and probably during vomiting); thirdly, an antero-posterior coaptation of the pulpy folds over the arytaenoid cartilages with the base of the epiglottis, as occurs during coughing, and in laryngeal stertor; and lastly, the closure of the rima glottidis during vocalisation. He has also shown ("Clinical Society's Transactions," 1877-8), that after the complete removal of the vocal cords, true and false, a sonorous though monotonous voice may be produced by the vibration of the same folds as are concerned in the production of laryngeal stertor.

ARTERIES.

The arteries of the larynx are derived from the superior thyroid, Fig. 2, *a*, and the inferior thyroid, Fig. 2, *d*. The former enters through the thyro-hyoid membrane, and divides

* It is not intended to imply that this is the only protection afforded during the act of swallowing.

into numerous branches; the latter enters beneath the inferior constrictor. The two anastomose freely.

NERVES.

The *superior laryngeal*, Fig. 2, 3, pierces the thyro-hyoid membrane, and divides into ascending and descending branches; it is distributed to the dorsum of the tongue and to the mucous membrane of the larynx and pharynx; one branch passes through the arytænoideus muscle.

The *external laryngeal*, Fig. 1, 6, supplies the crico-thyroid and part of the inferior constrictor.

The *inferior laryngeal*, Fig. 2, 4, enters the larynx at the lower part, and supplies branches to all the muscles except the crico-thyroid. It joins the superior laryngeal under the mucous membrane of the pharynx, and beneath the thyroid cartilage, and perhaps also in the substance of the arytænoideus muscle. It is essentially the motor nerve, as the superior laryngeal is the sensory nerve of the larynx.

PLATE 15

ILLUSTRATES the first view that is obtained on opening the abdominal cavity by a crucial incision, the vertical and horizontal parts of which cross at the umbilicus. It may be well to remind the reader at the outset that the position of the abdominal viscera with regard to the surface of the body varies, not only during life, as a result of the changes taking place from time to time in the contents of the viscera themselves, and the enlargement or contraction of the thoracic cavity consequent on respiration; but that after death their position depends upon the amount of their own dilatation or emptiness, and upon the extent to which the lungs were emptied during or after the final act of expiration. Their relations are also always more or less altered as they are seen in the dissecting-room, from the fact that those viscera which are in contact with the diaphragm during life drop away from it on the admission of air into the peritoneal cavity. If we think of these points, and remember also that the viscera themselves vary considerably in size, without any obvious departure from the healthy structure, it will be evident that any definite description of a normal position is at best only an approximation, and in no case represents a constant condition. In female subjects the effect of tight-lacing, by constricting the lower part of the chest walls, often produces very considerable displacement downwards of the stomach and liver, while in children the normal position of the organs differs decidedly from that which is found in the adult. In this particular case it should be added, there was a collection of fluid in the left pleura which no doubt displaced that side of the diaphragm to a slight extent, but this effect was minimized by the almost total collapse of the lung.

The position usually ascribed to the different viscera will be first given, it being understood that this applies to the case of the adult male subject. Afterwards any noteworthy modifications to be made will be dwelt upon.

All that should be seen on opening the abdomen is a portion of the left lobe of the liver occupying the subcostal angle, below this a portion of the right end of the anterior surface of the stomach, and often, projecting below the margin of the ribs, is the lower end of the gall-bladder; below the stomach, and covering all the intestines, is the great omentum, which is, however, tucked up in many cases so as to expose a greater or less amount of the small and large intestines. In this subject, as is often the case, the cæcum was uncovered. The viscera which lie beneath the great omentum and cause the eminences and depressions upon its surface, are the cæcum, ascending and transverse colon, and the small intestines; while the bladder, if much distended in the adult, or if slightly distended in the infant, and the uterus in the pregnant female, mount into the abdominal cavity.

The lower border of the liver corresponds in the mammary line very nearly with the margin of the ribs; traced forwards from this it keeps the same line till near the scrobiculus cordis, where it passes across the angle to the left cartilages. Traced backwards towards the posterior border, its downward limit varies greatly with the size of the organ and the amount of distension of the stomach and intestines, thus it may project considerably below the lower edge of the 8th, 9th, and 10th cartilages, or, on the other hand, it may fail to reach this line by a considerable distance. Its extent upwards varies with the position of the diaphragm—i.e., it will reach the level of the 4th rib, at its junction with the sternum in expiration, and that of the 6th rib in inspiration. The superficial dulness obtainable from the liver, depends upon the amount by which it is overlapped by the lung. It corresponds in front to the anterior part of the upper surface, and behind to the thick

posterior border. Its lower limit will be that indicated above as that of the viscus itself; its upper in the middle state between inspiration and expiration, is a line drawn from the upper border of the 6th rib in the nipple line, horizontally inwards, to the junction of the 6th cartilage with the sternum, thus crossing the 5th interspace, the 5th cartilage, and the 6th cartilage. Traced outwards and backwards it reaches the 8th cartilage at the mid-axillary line, and then passes backwards to the 11th dorsal spinous process (the 10th on the dead subject, the 12th during extreme inspiration). The liver dulness is continuous at the sternum with the superficial cardiac dulness. It will not be forgotten that the pleura, in any operation for puncturing the liver, intervenes between it and the surface of the body, except wherever or whenever it extends below the margins of the ribs. The length of the falciform ligament allows in rare instances a coil of distended intestine to pass between the upper surface of the liver and the diaphragm, and there can be no doubt that fluid in ascites, or gas which may exist in the peritoneal cavity as the result of perforation or otherwise, will in the recumbent posture occupy this interval. The first and last of these conditions will materially interfere with, or altogether abolish the liver dulness.

The gall-bladder always, or almost always, projects below the margin of the rib opposite the 9th cartilage.

It is not within the scope of this work to discuss all the causes of variation in the position of the liver, nor the question as to how far an enlargement of it may produce displacement of the neighbouring viscera upwards or downwards, but the following points may be mentioned. In children the lower border projects much further below the ribs than in adults; in women the constriction produced by tight-lacing often causes an excessive dislocation of the organ, so that its upper surface is almost completely in contact with, and with almost the whole extent of, the anterior abdominal parietes. The small lungs of some phthisical patients cause it to occupy a

higher position than normal, and the large lungs of emphysema make it descend. A similar effect is produced by the accumulation of fluid in the right pleura, or in the pericardium; that in the former cavity may be sufficient in quantity to cause complete inversion of the diaphragm, in which case, again, the liver will be completely in contact in front with the abdominal parietes.

The position of the *stomach* is liable to still greater variation than that of the liver, for when empty it often is not larger than a piece of the large intestine, but when much distended it projects downwards as far as or beyond the umbilicus. In what is described as the normal condition of a moderately distended stomach, a small portion only of the anterior surface appears in the sub-costal angle—i.e, it does not reach down as far as the level of the lower part of the epigastric region, the left end being covered by the chest-walls and the pylorus lying behind the liver. The most fixed portions of the stomach are the cardiac orifice, the small curvature, and the fundus, these parts being bound to the diaphragm, liver, and back of the abdominal walls by the small and gastro-splenic omenta. As a result of this the movement that takes place during distension is not simply one of descent, but of rotation forwards of its lower part which is free to move. It reaches upwards so as to occupy the left arch of the diaphragm where it lies below, and very slightly behind, the apex of the heart, and in front of the spleen and the left kidney. Its posterior surface is in relation besides with the aorta and vena cava, the pillars of the diaphragm and the pancreas. A large portion of the surface of the stomach is thus in contact with the chest walls, and the tympanitic note resulting from it is correspondingly extensive. The character of this note of course varies with the quantity of gas in the viscus, and as Sibson has pointed out, "Medical Anatomy," column 24, with the position of the body, for whilst this is erect the fluid contents gravitate to the front and diminish its extent in this

situation. This area is limited above and near the sternum by the lower border of the liver dulness; at the side in the mid state between expiration and inspiration, it occupies the sixth, seventh, and eighth spaces in front of the line of the anterior fold of the axilla. Behind this line the spleen is in contact with the chest walls. During inspiration and expiration it descends and ascends. If much distended it not only pushes the spleen backwards, but sometimes also the lungs upwards, so that under such a condition it gives a large area of tympanitic resonance in the axilla itself.

The *great omentum*, E, is a double fold of peritoneum, between the two parts of which the small sac of the peritoneum is prolonged downwards. Each part of it presents a serous surface both in front and behind, thus the anterior surface of the anterior part, and the posterior of the posterior, look towards the large sac of the peritoneum, while the two opposite surfaces, which are in apposition, form parts of the boundaries of the small sac. The anterior part begins above at the great curvature of the stomach, where it is formed by the apposition of the layers of peritoneum covering the anterior and posterior surfaces of this viscus; it is also attached to the spleen. The posterior portion ends above at the transverse colon, its two layers separating (in the adult) to include this part of the gut. The free border normally extends down so as to cover completely the small intestines, but extends lower on the left than the right side. It is liable, however, to very great displacements; thus it often leaves the cæcum uncovered as in the drawing, and is often drawn into the left hypochondriac region, so as to extend but a short distance over the small intestines. On the other hand it is frequently drawn in a mass into one of the iliac regions, or displaced irregularly to one side or the other. In the young subject it is a perfectly transparent delicate membrane, and its two parts can be readily separated, but in the adult they are usually more or less adherent, and

a larger or smaller quantity of fat is deposited in them, which sometimes is of considerable thickness. The vessels by which it is supplied come from the arteriæ gastro-epiploicæ dextra and sinistra.

It is very common for the great omentum to be included in herniæ; in the groin this is said to be more frequent on the left than the right side. If omentum alone be contained in a hernial sac the tumour will be solid to the touch, and there will not be a resonant percussion note, but these are not diagnostic of the condition, as a portion of gut which has entered a hernia may, of course, contain solid or fluid matter. It is a remarkable fact that the strangulation of a portion of omentum may produce symptoms indistinguishable from those which result from the nipping of a portion of gut. A piece of omentum that has long been retained in a hernia becomes, as a rule, much thickened. In such cases, if strangulation occur, it is advisable to remove the mass after applying one or more efficient ligatures to the pedicle; whilst doing so, however, it must not be forgotten that a piece of gut may have descended after the omentum, and thus be enclosed in a cavity at its upper part. The existence of such a piece, if small, may be easily overlooked. Collections of clear fluid are sometimes formed in the substance of a portion of omentum occupying a hernia. In making the diagnosis of abdominal tumours, it should be remembered that some forms may attack the omentum; such growths are liable to be mistaken for tumours of the particular viscus over which they happen to occur.

PLATE 16

Shows the branches of the superior mesenteric artery.

In order to prepare it, after the abdomen was opened, the large omentum, and with it the transverse colon, were lifted up and placed over the lower part of the chest walls. On doing so, the under surface of the transverse colon and transverse mesocolon were seen, and below them the mass of small intestines and the cæcum in the right iliac fossa. The small intestines were then pulled over to the left side, on doing which the right surface of the mesentery was fully exposed, and to the right of this a nearly square portion of peritoneum, bounded above by the transverse mesocolon, below by the ileum, to the right by the cæcum and ascending colon, and to the left by the mesentery. On removing this piece of peritoneum some branches of the superior mesenteric artery appeared superficially, and at a somewhat deeper level; after removing some fat areolar tissue and glands, parts of the third portion of the duodenum, and of the vena cava, ureter and spermatic vessels were shown, resting on the fascia covering the psoas muscle. The lower layer of the transverse mesocolon and the right layer of the mesentery were then removed, showing the superior mesenteric vessels and nerves with a considerable number of lymphatic glands (not shown). Lastly, in order to show the trunk of the superior mesenteric artery appearing from beneath the pancreas, the remaining—*i.e.*, the upper layer of the transverse mesocolon was slightly raised from its posterior attachment.

The *transverse mesocolon*, E, is the fold of peritoneum by which the transverse colon is attached to the back of the abdominal cavity. It is somewhat crescentic in shape, as the transverse colon is closely attached to the posterior wall of the

abdomen both at its hepatic and splenic flexures, but projects considerably forwards as well as downwards in the middle line, to form what is known as the arch of the colon. The two layers if traced forwards separate to receive the transverse colon; if traced backwards they are found to be attached to the second and third parts of the duodenum and the left kidney. At the posterior line of attachment these two layers separate, the lower passes down on each side over the structures lying at the back of the abdomen, and in the middle line is extended into the mesentery; while the upper ascends for the most part to form the posterior wall of the small sac of the peritoneum, but for a short distance to the right and left of the small sac it passes up to the liver and spleen respectively.

The *mesentery*, ζ, is the fold which connects the jejunum and the ileum to the spine. It is narrow behind, and is attached obliquely across the spine, reaching from the left side of the second lumbar vertebra, where the jejunum begins, to the left sacro-iliac articulation. It thus crosses the aorta and vena cava, and is attached at its lower part, where it is very short, almost immediately over the common iliac artery. Its width at its line of attachment to the intestine corresponds with the length of the jejunum and ileum together, and consequently the mesentery lies in numerous and deep folds. Between its two parts are contained the intestinal branches of the superior mesenteric vessels and nerves, the lacteals, and the lymphatic glands. These glands appear proportionally much larger in the infant than in the adult, they are liable to very great enlargement in several of the diseases affecting the intestinal tract.

It is a question of great interest to the surgeon to discover if the different parts of the small intestine occupy any constant positions in the abdomen, in order that he may be guided in the operation (gastrotomy) of opening the small intestine for the relief of obstruction.

As a general rule it may be stated that the coils of the jejunum

are higher up and further to the left than those of the ileum ; or in other words that the ileum is usually found in the neighbourhood of the right iliac fossa, and that it is more apt than the jejunum to descend into the pelvis. If a single small knuckle of intestine descend into a hernia in the groin, it is more likely to be ileum than jejunum, and on the right side it is not very uncommon to find one of the last coils of the ileum in an inguinal or femoral rupture. But the important question is whether the lower part of the ileum will present in an incision made as Trousseau and Nélaton recommended, for an inch or more a little above the crest of the ileum, and parallel with Poupart's ligament (Trousseau's "Lectures on Clinical Medicine," LXXVII. : Intestinal Occlusions) or more exactly, a little below the mid-point of a line drawn from the umbilicus to the right anterior superior iliac spine. Trousseau says that this is usually the case, but Drs. Greenfield and Coupland, and Mr. McCarthy have shown (Clinical Society's Transactions, *Lancet*, Oct. 31, 1876, p. 576) that while this is most commonly the case, in some subjects other portions of the intestine will make their appearance in the wound—*e.g.*, the cæcum, the ileum at a distance of several feet from the end, or even the jejunum, may occasionally be opened by such an operation instead. The bearing of the question is obvious, for if the obstruction be situated in the small intestine, and the cæcum be opened, no relief will of course be obtained ; while, on the other hand, an opening made in the jejunum may, by cutting off such a considerable portion of the alimentary tract, seriously interfere with the process of nutrition. The relative merits of this operation with that of Littré and Amussat will be better discussed in connexion with the last—*viz.*, colotomy.

ARTERY.

The *superior mesenteric, a*, leaves the aorta below the celiac axis, and passes downwards immediately, behind the

pancreas. In this position the splenic vein crosses it, and the left renal vein lies behind it. It appears in the Plate between the lower border of the pancreas near its head and the duodenum, and crossing the anterior surface of the latter, divides into branches for the small and large intestine.

From the left side are given off the *vasa intestini tenuis*, *b, b, b*, twelve to fifteen in number, which running outwards in the mesentery divide into branches, which anastomose freely, forming four or five series of loops. When these reach the attached border of the intestine they give branches to both surfaces, which break up into numerous ramifying twigs. These vessels supply the whole of the jejunum and ileum.

From the right side are given off the *inferior pancreatico-duodenal*, *f*, which runs to the right between the head of the pancreas and the duodenum to anastomose with the superior pancreatico-duodenal from the hepatic.

The *middle colic*, *e*, which passes forwards in the transverse mesocolon to the transverse colon, and divides into two large branches, which inosculate with the right and left colic arteries.

The *right colic*, *d*, which passes out to the ascending colon, and anastomoses with the preceding and following vessels.

The *ileo-colic*, *c*, which runs out to the cæcum which it supplies, sending a branch down to the end of the ileum.

VEINS.

The *superior mesenteric*, *a*, receives tributaries corresponding to the branches of the artery it accompanies. The trunk disappears beneath the pancreas to join with the splenic vein in the formation of the portal, and lies to the right of the artery.

Attention is directed to the close relation of the vena cava to the ureter as it is here exposed.

NERVES.

The *sympathetic plexus*, on the superior mesenteric artery has been represented in part. This will not be done in other drawings of the abdomen, but it must be remembered that similar plexus accompany all the visceral branches of the abdominal aorta and the diaphragmatic artery.

PLATE 17.

IF the dissection of the abdomen has been carried to the stage represented in Plate 16, the appearance here shown will be obtained by carrying out the following steps.

A ligature is first placed round the commencement of the jejunum, Plate 16, ι , and the end of the transverse colon, Plate 16, δ . The whole of the jejunum and the ileum, with the cæcum, the ascending and the transverse colon and the great omentum are removed by dividing the mesentery, stripping up the cæcum and ascending colon from the subjacent structures, and cutting through the great omentum at its upper part. The last step involves the replacing of the transverse colon in its normal position. If now the stomach be raised into the position shown in the Plate, the cavity of the small sac is completely opened up, and the pancreas and cœliac axis may be exposed by raising the peritoneum from their surface—this piece of peritoneum being the ascending layer of the transverse mesocolon, or, in other words, the posterior layer of the small sac. All the other structures shown may be now exposed by the removal of the loose fat and cellular tissue covering them.

The principal object of the dissection is to show the inferior mesenteric artery and the cœliac axis.

The *second and third parts of the 'duodenum*, 5, are now seen *in situ*; the *first* has been turned upwards with the stomach. The *first part* occupies a level slightly anterior to that of the other two; it ascends from the pylorus to the gall-bladder, and is inclosed between the two layers of the small omentum in the same manner as the stomach. In its *second or descending portion* the duodenum first comes in contact with the head of the pancreas. This part touches behind the right

kidney with its vessels and duct, and the pancreatic and common bile-ducts. It is crossed obliquely by the transverse colon. The two layers of peritoneum surrounding the latter pass upwards and downwards over it, binding it closely to the parts behind. It extends downwards at least as far as the level of the third lumbar vertebra. *The third or inferior transverse portion* ascends in a sharp curve, so as to reach the left side of the second lumbar vertebra where it is continuous with the jejunum. In this course it rests upon the psoas muscle, the spermatic vessels, the ureter, the vena cava, the aorta, and the inferior mesenteric artery. The transverse mesocolon crosses it longitudinally, and its two layers, as in the case of the second portion, passing upwards and downwards, attach it closely to the parts beneath. This portion is in close contact with the head of the pancreas, and is crossed by the superior mesenteric vessels as they pass into the mesentery.

The reader will not fail to notice how near the duodenum comes to the level of the bifurcation of the aorta. The distance is, however, in some cases slightly greater.

The *pancreas*, 2, is a long gland obviously lobular upon the surface, narrow and thin at the left end, which is called the *tail*, and which touches the inner surface of the spleen; wider and thicker at the other extremity, where it is bent downwards and then to the left to form the *head*, which is inclosed in the curve formed by the second and third parts of the duodenum. The tip of this bent portion projects beneath the superior mesenteric vessels. The peritoneum which forms the posterior wall of the small sac, covers its anterior surface, while its posterior surface is in contact with the pillars of the diaphragm, the aorta, and the vena cava, the portal, inferior mesenteric, splenic, and left renal veins, and the left kidney.

In order to understand the *small sac of the peritoneum* it is well to consider, in the first place, what would be the condition of things if it did not exist. The great omentum would

consist of two layers only, those which are now the most anterior and the most posterior; the back of the stomach and duodenum would be in contact with the pillars of the diaphragm, pancreas, &c., while the part which corresponded to the anterior layer of the small omentum would then cover the part of the liver behind the transverse fissure, with the hepatic artery and portal vein, bile-duct, &c. In order to reach the interval between the structures which would under these circumstances have been in contact, we may imagine the peritoneum tucked in immediately to the right of the hepatic artery and portal vein. The meaning of this, and the manner in which the two sacs communicate, is apparent from the diagram (p. 178). The small sac extends upwards as far as the transverse fissure of the liver and the œsophageal opening in the diaphragm; downwards to the free border of the great omentum; to the right as far as the foramen of Winslow, the second part of the duodenum, and the right border of the great omentum; and to the left as far as the great curvature of the stomach and the left border of the great omentum.

Attention is directed to the extent to which the two kidneys are exposed at this stage of the dissection. The amount of spleen seen in this preparation was somewhat larger than usual.

ARTERIES.

The *cœliac axis*, *d*, is a short, thick trunk, which leaves the front of the aorta immediately after it has passed beyond the diaphragm, and runs forward above the upper border of the pancreas. On reaching the level of the anterior surface of the gland, it divides into three trunks, which make their way to their several destinations behind the peritoneum forming the posterior wall of the small sac.

The *coronary*, *m*, runs upwards to the œsophageal opening in the diaphragm, where it passes between the two layers of the small omentum, and, following the line of the small

curvature of the stomach, supplies some œsophageal branches, and others both to the anterior and posterior surfaces of the stomach, and ends by anastomosing with the superior pyloric artery near the pylorus.

The *splenic, j*, is the largest of the three. It passes to the left with a very tortuous course, embedded in a groove along the upper border of the pancreas, and ends by numerous branches which enter the hilus of the spleen. In its course it supplies some branches, *vasa brevia, l*, to the fundus of the stomach; a long branch, the *gastro-epiploica sinistra, k*, which follows the great curvature of the stomach from left to right, and anastomoses with the *gastro-epiploica dextra*; and lastly, others to the substance of the pancreas, of which the largest is called *arteria pancreatico magna*.

The *hepatic, e*, runs forwards and to the right below the foramen of Winslow as far as the first part of the duodenum, where it turns upwards between the two layers of the small omentum, in front of the foramen of Winslow, to end in two branches for the supply of the right and left lobes of the liver, of which the former gives a small cystic branch to the gall-bladder. In its course it supplies the large *gastro-duodenal, f*, and the small *superior pyloric branch*. The former, after passing behind the pylorus, gives off the *inferior pyloric, i*, and divides into: the *gastro-epiploica dextra, h*, which follows the large curvature of the stomach, and ends by anastomosing with the *gastro-epiploica sinistra* from the splenic; and the *superior pancreatico-duodenal, g*, which runs downwards between the pancreas and duodenum to anastomose with the *inferior pancreatico-duodenal* from the superior mesenteric (*see p. 163*).

The *inferior mesenteric artery, q*, leaves the front of the aorta as it is being crossed by the third part of the duodenum, between one and two inches above its bifurcation. Its course is downwards over the left common iliac vessels into the pelvis, where it ends at the back of the rectum in the *superior hæmorrhoidal branch, t*. This divides first into two, and these

subsequently break up into six or seven, long branches, which run down between the muscular and mucous coats as far as the anus, anastomosing with the middle and inferior hæmorrhoidal arteries. The other branches of the inferior mesenteric are the left colic and the sigmoid. The *left colic*, *r*, passes over the left kidney to the descending colon and divides into loops in the same manner as the branches of the superior mesenteric, for the supply of the large intestine; it inosculates above with the middle colic and below with the sigmoid. The *sigmoid*, *s*, passes between the layers of the sigmoid mesocolon to the sigmoid flexure which it supplies. It anastomoses with the left colic and the superior hæmorrhoidal.

The aorta itself and its remaining branches will be described in connexion with the following Plate.

VEINS.

It is only necessary now to mention the fact that the *inferior mesenteric vein*, *ε*, runs upwards to the left of its companion artery and passes beneath the pancreas to enter the splenic vein. It receives tributaries corresponding to the branches of the artery.

PLATE 18.

THIS drawing illustrates the next stage in the series of dissections which have been shown in the three foregoing Plates.

It was prepared from that given in Plate 17 by removing, in the first place, the descending colon and the sigmoid flexure, with their vessels; then taking away the stomach and duodenum, by dividing the œsophagus, cutting through the small omentum and separating the duodenum and pancreas from the structures on which they rest, while the folds of peritoneum attaching the spleen were divided, and the branches of the cœliac axis were cut short. The right kidney and supra-renal capsule were removed after dividing the vessels and the ureter, and the liver was taken away by dividing its several ligaments, care being taken to cut the hepatic veins before they entered the vena cava without injuring the latter. The remaining portions of peritoneum were then cleared away from the diaphragm, and the other structures exposed in the abdomen. The skin and subcutaneous fat were removed by irregular incisions from the upper part of both thighs; and on the left side, that portion of the fascia lata which forms the roof of Scarpa's triangle was in part taken away, so as to expose the sheath of the femoral vessels and the deeper portions of fascia lata covering the muscles which bound Scarpa's triangle, during which process some branches of the anterior crural nerve were shown, and the trunk of the nerve was afterwards uncovered by removing a little of the fascia over it. The fascia transversalis was then separated from the flap consisting of the abdominal muscles, and the latter was divided by a vertical incision leading down to Poupart's ligament. The part internal to this incision was then cleared away, including fibres of the external oblique attached to the pubes, the inser-

tion of Poupart's ligament, the conjoined tendon, and the origins of the rectus abdominis and transversalis. The fascia transversalis was afterwards fixed nearly in its natural position, while the cremaster was divided, and the infundibuliform fascia was defined.

On the right side the fascia lata forming the roof, and that part which covers the muscles at the outer side of Scarpa's triangle, were taken away. A similar incision was made in the flap of the abdominal wall, but without preserving the fascia transversalis; the parts internal to this incision were then completely cleared away, and the remains of the fascia transversalis, the fascia iliaca, the femoral sheath, and the fascia over the psoas, were removed. In order to uncover the iliacus nearly to its termination, the sartorius was cut, and the divided ends were turned inwards and outwards. The suspensory ligament of the penis had previously been defined.

The *fascia over the psoas*, †††, has attachments above, corresponding almost with the attachments of the muscle—i.e., internally to the intervertebral substance and the contiguous parts of the bodies of the vertebræ above and below, and also to the ligamentous arches from which the muscle arises; externally, it blends with the fascia over the quadratus; above, it is fixed to the ligamentum arcuatum internum; below the level of the fifth lumbar vertebra the fascia is attached internally to the ilio-pectineal line, while externally it blends with the fascia iliaca, and with it passes down into the thigh behind Poupart's ligament and the femoral vessels. Along the ilio-pectineal line is a strong band of fibres which is continuous above with the psoas and iliac fascia, and below with the pelvic fascia.

The *fascia iliaca*, ††, is attached above round the origin of the iliacus muscle, to the crest of the hip-bone and the ilio-lumbar ligament; internally it blends with the psoas fascia, externally with the fascia transversalis. Below it is in part attached to Poupart's ligament, where it is continuous with

the fascia transversalis; but opposite the vessels it passes down in common with the psoas fascia into the thigh behind the vessels, and, keeping in contact with the muscles, it is continuous with the fascia lata over the pectineus muscle, and is attached to the small trochanter and the line leading from it to the linea aspera. If these fasciæ be considered together, the thickest part is below; here it passes across both the subjacent muscles, and to this part the psoas parvus, if present, is closely connected. From the combined psoas and iliac fascia is given off, a little above Poupart's ligament, the posterior layer of the sheath of the femoral vessels.

The *quadratus fascia* is in reality the anterior layer of the aponeurosis of the transversalis muscle. It covers the muscle, and is attached internally to the tips of the transverse processes of the lumbar vertebræ in common with the outer part of the psoas fascia; between the transverse processes it sends in strong slips which reach almost up to the bodies, leaving only a space for the passage of vessels and nerves; below, it is attached to the ilio-lumbar ligament, and above it is thickened so as to form the ligamentum arcuatum externum, extending from the last rib to the first or second lumbar vertebra.

The *fascia transversalis*, †, lines the interior of the abdominal walls, and is only to be distinguished as a separate structure below and in the loins. It is attached below to the pubes and the inner part of the pectineal line. It then passes down in front of the vessels, forming the anterior part of their sheath. External to the vessels it is attached to Poupart's ligament and the crest of the ilium, along which lines it is continuous with the fascia iliaca, and higher up, it is thinner and gradually disappears. Above the vessels it sends down a prolongation, the infundibuliform fascia, round the cord, and beneath Poupart's ligament is a strong band of transverse fibres of varying thickness, called *the deep crural arch*, which blends externally with Poupart's ligament, and internally is attached to the pectineal line. It crosses the vessels, and is an occasional cause of stricture in femoral hernia.

The bearing of these fasciæ upon the course of abscesses is of importance to the surgeon. If pus resulting from caries of the anterior part of the spinal column have made its way into the psoas muscle, it will be directed downwards by the sheath to a point behind and external to the vessels at Poupart's ligament. Here it will probably pass to a small extent into the sheath of the iliacus, and then make its way down into the thigh, external to the vessels. Its course will next be downwards towards the small trochanter, after which, if it progress further, it must burst through the fascia, and then will take the direction of least resistance, guided by the profunda artery and other vessels—viz., to the inner side of the great vessels, where it usually points. If, however, pointing do not take place here, the matter may make its way down the inner side of the thigh to the popliteal space, the calf, or even the ankle. An abscess existing in the sheath of the psoas, but seldom burrows into the pelvis. The not very uncommon cases in which caries of the spine leads to a pelvic abscess which may make its way through the great sacro-sciatic notch to the buttock, are usually those in which the matter has passed downwards beneath the anterior common ligament of the vertebræ.

Abscess in connexion with disease of the venter of the ilium, after filling the sheath of the iliacus, often points above Poupart's ligament, external to the vessels, but may descend into the thigh outside the vessels. An abscess arising superficial to the fascia—i.e., one in connexion with gland, intestine, kidney, &c., will point above Poupart's ligament, a fact of great importance in diagnosis. The reader will remember that it is chiefly chronic abscesses to which these rules apply, a very acute one making its way often independently of such obstructions as the fasciæ oppose.

The surgical importance of the fascia transversalis will be best considered in connexion with the description of the groin and the lumbar region.

The *suspensory ligament of the penis*, ++, is an elastic and

thin fascia attached above to the point of the pubes, and splitting below into two parts, which pass downwards on each side of the penis. As the two parts separate the dorsal vein is seen to pass backwards between them, with the dorsal artery and nerve on either side of it.

The manner in which the sheath of the femoral vessels is constructed may be studied from this Plate, but the description of it will be given with that of the groin, Plate 20.

MUSCLES.

The *diaphragm*, F, is a thin muscular septum between the cavities of the thorax and abdomen. It forms a dome, the margin of which corresponds with the lower part of the rib cartilages and the arcuate ligaments; it extends upwards to different heights on the two sides, and these heights are again modified by the act of respiration. Thus while at the xiphoid appendix or cartilage the height does not vary to any extent, the right side reaches the level of the junction of the fourth rib cartilage with the sternum in deep expiration, and the sixth in full inspiration, while the left side does not rise so high by the width of a rib. The muscle arises from the back of the xiphoid appendix E, the margins of the lower six rib-cartilages and the bone of the seventh rib, the ligamenta arcuata, and by two strong portions called the pillars, from the sides of the bodies of the upper lumbar vertebræ. Of these pillars the right is the larger and the more anterior: it is attached to the first three vertebræ, and the intervertebral substance between the third and fourth. From the outer part of each pillar some tendinous fibres arch outwards over the psoas muscle, and are attached to the transverse process of the first or second lumbar vertebra, forming the ligamentum arcuatum internum. The inner fibres of the two sides decussate, (those of the right side being usually the more superficial), crossing in front of the aortic opening. After decussating they pass round the sides of the œsophageal opening, and end in the central

tendon. On each side of the origin from the xiphoid cartilage, is a small interval, through which pass the internal mammary vessels. A similar interval, or sometimes, as in this case, more than one, is found external to the origin from the ligamentum arcuatum externum. The origin from the rib cartilage is by slips which interdigitate with those of the transversalis muscle.

The insertion of the muscle is into a central tendon F, which consists of three oval portions united together, thus bearing some resemblance to a trefoil leaf. The lateral portions form the highest parts of the dome; in the right one is a squarish opening through which passes the vena cava inferior.

The œsophageal opening is surrounded by muscular fibres, except in rare cases, when it is tendinous anteriorly; it transmits in addition to the œsophagus, the pneumogastric nerves and some vessels. The aortic opening is better described as being behind rather than in the diaphragm; it transmits the thoracic duct and the vena azygos major. The splanchnic nerves and the vena azygos minor pass through the substance of the pillars.

The diaphragm is the principal muscle of respiration; as it contracts the height of its dome is diminished and the capacity of the thorax is increased, while the cavity of the abdomen is altered in shape, but the size of the latter is diminished if any of its contents be at the same time expelled, as in the act of vomiting. Spasmodic contraction of the diaphragm gives rise to hiccough, a point which it is important to remember in cases where damage to the phrenic nerve, or local irritation of the diaphragm from peritonitis or other causes may be expected. A certain diminution in the size of the œsophageal opening must occur during contraction of the muscle.

Diaphragmatic hernia, or the protrusion of some of the abdominal viscera into the cavity of the thorax, may occur either as the result of a congenital deficiency of some part of the muscle, a rupture of the muscle. or even as the result of a

stab inflicted from outside. The instances of deficiency or rupture have occurred mostly on the left side; the viscera most commonly included are the stomach and transverse colon, but others have been found in such a hernia.

The *psoas magnus*, I, arises from the bodies of the last dorsal and all the lumbar vertebræ, from the intervertebral discs, and from tendinous arches bridging across the concave part of each vertebra, and also from the inner part of the transverse processes of all the lumbar vertebræ. It has a tendinous insertion into the posterior part of the small trochanter of the femur. Its tendon is joined by many fibres of the iliacus. Thus while the greater part of the muscle is in the abdomen the highest part is in the thorax, and the insertion is in the upper part of the thigh. It rests upon the transverse processes of the lumbar vertebræ, the brim of the pelvis, the notch in the innominate bone below the anterior inferior iliac spine, and the hip-joint. It also overlaps the quadratus and the iliacus muscles, though the latter is anterior to it at its insertion. In contact with its anterior surface are the diaphragm and the internal arcuate ligament, the kidney and its vessels, the ureter, the spermatic vessels, the external iliac artery, the genito-crural nerve, the *psoas parvus* (if present), Poupart's ligament, the femoral artery, and some branches of the anterior crural nerve. To its inner side above is the chain of sympathetic ganglia, with the vena cava on the right side and the aorta on the left; lower down the common iliac vessels and, in the thigh, the pectineus and the internal circumflex vessels. External to it are several branches of the lumbar plexus and the iliacus muscle. In the substance of the muscle are the nerves of the lumbar plexus. A bursa intervenes between its tendon and the hip-joint, with which it generally communicates. The action of the muscle is principally to flex the hip-joint; it is doubtful whether it acts at all as a rotator of the femur, and very doubtful if it be a rotator out.

The *psoas parvus*, J, only occasionally present, arises usually from the bodies of the twelfth dorsal and first lumbar vertebræ and the intervening fibro-cartilage. It spreads out into a wide tendon which is intimately connected with the psoas fascia, and is inserted into the pectineal eminence on the innominate bone. Its action is to flex the lumbar spine.

The *iliacus*, K, arises principally from the venter of the ilium, but also from the ala of the sacrum. The fibres converge and join the tendon of the psoas. The outermost fibres are inserted just below the tendon of the psoas on a triangular space immediately below the small trochanter, and a few sometimes end on the capsule of the hip-joint. The muscle rests upon the venter ilii and the hip-joint. Between it and the margin of the pelvis is a small bursa. Resting upon it is the cœcum on one side, and the sigmoid flexure on the other, the ilio-inguinal and external cutaneous and anterior crural nerves, and in the thigh the sartorius muscle. In the groin, between it and the psoas, is the anterior crural nerve, and some of the branches of the nerve are superficial to it. At its insertion the profunda vessels lie between the muscle and the femoral artery. The origin of the rectus femoris is beneath its outer border. It acts as a flexor of the hip only.

The *abdominal aorta*, a, is about five inches long, and extends from the aortic opening of the diaphragm, opposite the lower border of the body of the twelfth dorsal, to the front of the body of the fourth lumbar vertebra. The bifurcation is usually almost in the middle line, but sometimes a little to the left. It rests upon the spine, and the receptaculum chyli. It is crossed by the pancreas and duodenum, the left renal and splenic veins, and part of the solar and the aortic plexuses. The mesentery and the peritoneum upon each side of it, cover the front of the aorta. To the right side is the vena cava.

The aorta has been tied on seven occasions ("Erichsen's Surgery," 7th Edit. vol. ii. p. 147), in some cases by incisions

near the middle line, in which the peritoneum was opened, the intestines pulled aside and the artery exposed from the front ; in others by prolonging upwards the incision for ligaturing the common iliac (*see* page 181). All the cases have proved fatal. The aorta close to its bifurcation can in most people be felt pulsating. The point usually given as the guide on the surface to the bifurcation is a little to the left and slightly below the umbilicus, or on a level with the highest part of the iliac crests ; but as the umbilicus and the point of bifurcation both vary somewhat in level, and as the artery is often almost, if not quite, in the middle line, it is wisest in applying the aortic tourniquet to determine its position if possible by feeling for it. The amount of pressure required in order to stop the flow of blood is not great, but it should be remembered that undue pressure may cause considerable damage to the structures which may intervene between the pad of the instrument and the spine.

Some branches of the abdominal aorta remain to be described.

The *diaphragmatic*, *b*, *b*, or *inferior phrenic*, leaves the aorta immediately after its passage behind the pillars of the diaphragm, sometimes separately, often together, and often one or both in connexion with the cœliac axis. The left supplies a few twigs to the œsophagus. They both give branches to the supra-renal capsule, *superior capsular*, *j*, and then run out to their respective sides, the right passing behind the vena cava, the left behind the œsophagus. Their branches take very much the course of the circumference of the three leaflets of the central tendon. They anastomose with the intercostal arteries, and two branches of the internal mammary, the musculo-phrenic, and the comes nervi phrenici, sometimes called superior phrenic.

The *supra-renal* or *middle capsular*, *k*, are two very small arteries, which leave the aorta nearly on the same level as the superior mesenteric. They run straight out to the supra-renal capsules and anastomose with the superior and inferior capsular.

The *renal arteries*, *h, h*, are two large trunks which leave the sides of the aorta below the level of the superior mesenteric, and pass outwards and slightly downwards to the kidneys. They supply small branches, *inferior capsular, l*, to the supra-renal capsules, and others to the ureters and the fat around them, and divide into four or five large trunks which enter the hilus of the kidney. The right artery is rather longer than the left, it passes behind the vena cava. Each vessel lies behind its accompanying vein, and the terminal branches are in front of the ureter.

The *spermatic arteries, m, m*, arise from the front of the aorta below the renals, and are directed downwards with a somewhat wavy course over the psoas muscles to the internal abdominal ring, where they enter the spermatic cord and are continued to the testicles. The right artery usually crosses the vena cava. Both cross the ureter and external iliac artery of their own side. In the scrotum they become very tortuous.

The *middle sacral, p*, arises from the back of the aorta close to the bifurcation. It descends behind the left common iliac vein, resting upon the front of the sacrum as far as the coccyx, anastomosing with the lateral sacrals on either side of it.

The *common iliac arteries, o, o*, result from the bifurcation of the aorta. They are directed downwards and outwards as far as the lumbo-sacral articulation. Thus each vessel is about two inches long, but this is liable to considerable variation. The right is often slightly longer than the left.

The *right artery* lies upon the bodies of the fourth and fifth lumbar vertebræ, both common iliac veins, and generally on the commencement of the vena cava; the psoas, and parts of the right common iliac vein and vena cava are to its outer side, and it is crossed by the termination of the mesentery, and, like the left, by the ureter, if this does not cross the external iliac.

The *left artery*, which was here longer than the right, is crossed by the inferior mesenteric vessels, and lies above its companion vein.

The *external iliacs*, *q, q*, extend downwards in the same direction as the common iliacs, which would be indicated on the surface of the body by a line drawn from a little to the left of the umbilicus and slightly below it, to a point midway between the symphysis pubis and the anterior superior iliac spine. Each vessel is covered by the peritoneum, and crossed by the following structures, taken in order from above down: the ureter in many cases, the spermatic vessels, the genitocrural nerve, and the circumflex iliac vein. The vas deferens passes over its inner side. The ileum lies over the right, the sigmoid flexure over the left vessel. The artery rests on the inner side of the psoas, and on the right side upon its own vein. At the lower part the veins on both sides are internal to the arteries, but they gradually pass behind them.

The operations for tying the external iliac are two; they are modifications of the plans suggested by Abernethy and Sir A. Cooper. The former consists in making a curved incision, the concavity of which is upwards and inwards, from a point two finger-breadths to the inside of and a little above the anterior superior spine of the ilium, to another slightly outside, but an inch and a half above, the middle of Poupart's ligament. The three large muscles of the abdomen are carefully cut through, and then the fascia transversalis is raised in the forceps and nicked at the lower part of the wound. It is then divided on a director, or more safely torn with the finger, and afterwards the peritoneum is raised until the artery is reached. The needle is passed from the inner side in order to avoid the vein. Sir Astley Cooper's operation is commenced by an incision three inches long, a little above and nearly parallel to Poupart's ligament, extending from a point just outside the external abdominal ring, and ending near the anterior superior spine. After cutting through the tendon of the external oblique the sper-

matic cord is seen passing from beneath the internal oblique and transversalis muscles ; and on cutting through the cremaster and fascia transversalis this can be lifted up with the peritoneum, and the vessel is reached just above the point at which the epigastric artery leaves it. By means of the same incision the artery can be exposed for another inch and a half.

Sir Astley Cooper's method is said to involve less injury to the abdominal walls, and to be therefore less likely to be followed by hernia ; but it has the following disadvantages : the artery can only be reached a short distance above its termination ; the spermatic cord, the epigastric vessels and the circumflex iliac vein may give the surgeon some trouble, and are even liable to injury. The genital branch of the genito-crural nerve must be separated from the artery.

The *common iliac* may be tied by prolonging Abernethy's incision for the external iliac vessel, upwards and slightly inwards ; or a curved incision may be made from the tip of the last rib extending downwards and forwards for from four to six inches. The muscles are divided one by one, and the peritoneum raised as before.

The *circumflex iliac artery*, *s*, arises from the external iliac near its termination, and runs outwards on the iliacus to the crest of the hip-bone, the course of which it follows, giving branches to the iliacus and abdominal muscles ; it anastomoses with the ilio-lumbar artery.

The small *pubic*, *u*, and *cremasteric*, *v*, branches of the epigastric are shown in the Plate.

VEINS.

The *external iliac veins*, κ , κ , are at first internal to their respective arteries, but afterwards they pass behind them. Each receive tributaries corresponding to the branches of the artery. The circumflex iliac veins are two in number, but unite into one trunk which crosses the external iliac artery an inch

from its termination. The epigastric veins are also two, but unite into one before their termination.

The *common iliac veins* have different relations to their respective arteries. The right is at first behind, and then partly to the outer side; while the left is below, and separated often by a slight distance from its accompanying vessel. The point of junction of the two common iliac veins is often slightly to the left of the right common iliac artery, but in some cases it is completely to the right of this vessel. The left, like the right, lies partly underneath the right common iliac artery. Each receives tributaries corresponding to the ilio-lumbar and lateral sacral arteries, and the left receives also the middle sacral vein.

The *ascending or inferior vena cava, a*, begins either just to the right or beneath the right common iliac artery—*i.e.*, opposite the fifth lumbar vertebra. It extends upwards on the right side of the aorta until this vessel passes through its opening in the diaphragm, after which it is directed upwards and slightly forwards as far as its own opening, which is at the junction of the right and central leaflets of the tendon of the diaphragm. The vein rests on the bodies of the vertebræ, the lumbar arteries, the chain of sympathetic ganglia, the origin of the right psoas, the diaphragm, and the right renal artery. In front of it are the peritoneum, the third part of the duodenum, the pancreas, the foramen of Winslow, the liver, the portal vein, and usually (though not in this case) the right spermatic artery.

The *spermatic veins* accompany the arteries of the same name; the right enters the vena cava, the left the renal vein.

The *renal veins, γ, γ*, pass inwards from the kidneys, each being superficial to its artery. The left, which is longer and also somewhat higher than the right, crosses the aorta immediately below the origin of the superior mesenteric artery, and is itself crossed obliquely by the splenic vein. It is to be found behind the pancreas, while the right is behind the second part of the duodenum. These veins usually receive tributaries from the

supra-renal capsules, and in this subject the left was also joined by the phrenic vein.

The *capsular veins* open, on the right side, into the cava, on the left into the renal vein.

The *phrenic veins* usually follow the same course as the arteries, but in this case the left entered the renal vein.

The *hepatic veins*, β , are usually three large trunks coming from the liver which enter the vena cava close to its termination.

Part of the *portal vein*, η , was left *in situ* with the large trunks of the *superior mesenteric*, δ , and *splenic*, ϵ , which form it ; and also the *inferior mesenteric*, ζ , joining the latter. The vein commences behind the pancreas in front of the vena cava ; it extends upwards, forwards, and slightly to the right, in front of the foramen of Winslow, between the layers of the small omentum, to reach the transverse fissure of the liver where it divides into a right and left branch for two lobes of that organ. The right usually receives the cystic vein from the gall-bladder, and the coronary vein enters the portal trunk itself ; the other branches corresponding to the arteries supplying the chylopoietic viscera, make their way into the trunks from which the portal vein is formed ; thus, the superior mesenteric receives the pancreatico-duodenal and the right gastro-epiploic, and it, as well as the inferior mesenteric and splenic, have tributaries answering to the branches of their corresponding arteries.

NERVES.

It will be only necessary here to point out that the *last dorsal nerve*, 2, is seen immediately below the twelfth rib, that the *ilio-hypogastric*, 3, *ilio-inguinal*, 4, *external cutaneous*, 5, and *anterior crural*, 7, make their appearance at the outer border of the psoas muscle ; while the *genito-crural*, 6, lies upon its anterior surface. It will also be noticed that the ilio-hypogastric rests on the quadratus, the ilio-inguinal on the quadratus and iliacus, and the external cutaneous on the iliacus

only. The external cutaneous in this subject supplied an irregular branch, which joined one of the middle cutaneous branches of the anterior crural nerve.

The phrenic, 1, is distributed by two or three branches on the under surface of the diaphragm.

PLATE 19.

FIG. 1.

THIS is the first of a series of four dissections which illustrate the parts concerned in the anatomy of inguinal and femoral hernia.

An incision was made from the anterior superior spinous process of the ilium inwards to the middle line, and vertical ones were carried downwards from its two ends, one for about seven inches in the thigh, and the other to the root of the penis. Another horizontal incision was made across the front of the thigh to join the outer perpendicular incision; and from the ends of this and the inner perpendicular incision, others were carried to about the middle of the outer part of the left side of the scrotum.

The superficial layer of the superficial fascia was then removed, exposing the vessels and nerves of this region resting upon the deep layer of the superficial fascia.

The *superficial layer of the superficial fascia*, †, †, resembles that found in other parts of the body, and contains a variable amount of fat, except in the scrotum, where it becomes thin and membranous, and contains involuntary muscular fibre, forming what is known as the *dartos*. This superficial layer passes over Poupart's ligament without being attached to it; it is also continuous with the corresponding layer of fascia in contiguous parts of the body, and by means of the fascia in the scrotum with the superficial layer of the superficial fascia in the perinæum.

The *deep layer of the superficial fascia*, ‡, is thin and membranous, and requires a different description for its various parts. Over the lower part of the abdomen it forms a distinct layer, which gives a covering to the penis and sends a funnel-

shaped prolongation over the spermatic cord into the scrotum, where it is continuous with the deep layer of the superficial fascia in the perinæum. It is firmly attached just below Poupart's ligament to the fascia lata of the thigh, and more internally to the symphysis pubis, the ramus of the pubes, and, as will be afterwards seen (Plate 21), to the base of the triangular ligament. It thus bounds a triangular space, the apex of which is directed downwards towards the pubes, and is prolonged into the perinæum, giving coverings to the penis and scrotum. It is this fascia which guides an inguinal hernia into the scrotum or labium, as the case may be, or which influences the shape of the swelling caused by extravasation of urine.

In the thigh the deep layer of the superficial fascia is also thin and membranous, but it is scarcely to be distinguished as a distinct membrane except in the vicinity of the vessels, and here, in most cases, only with difficulty. It bridges over the saphenous opening, and is perforated by numerous vessels and lymphatics, for which reason it is called the *cribriform fascia*.

Between these two layers is a collection of lymphatic glands which are arranged in two series: one perpendicular, lying along the saphenous vein, and receiving their supply of lymph from the lower extremity; the other along Poupart's ligament—i.e., horizontal in direction—and receiving their supply of lymph from three sources, the lower part of the abdominal wall, the penis and scrotum, and the anus. It is important to remember these possible sources of irritation, all of which require investigation before a bubo in the groin can be pronounced an idiopathic glandular swelling.

ARTERIES.

Four branches of the femoral artery supply this area; they anastomose with twigs derived from the deep epigastric, *d, d*, and the lower intercostals. They are as follows:—

The *superficial epigastric, b*, perforates the fascia lata

immediately over the artery and runs upwards over Poupart's ligament to the front of the abdomen.

The *superficial circumflex iliac*, *c*, pierces the fascia lata at the outer part of the thigh and runs outwards and upwards towards the iliac crest.

The *superficial external pudic*, *a*, comes through the saphenous opening, and is directed inwards to supply the inner and upper part of the thigh, and the scrotum or labium. It anastomoses, like its deeper companion, with the superficial perineal from the internal pudic.

The *deep external pudic* (Fig. 2, *b*) passes inwards beneath the fascia lata to the inner border of the thigh, where it perforates the fascia and is distributed in the same manner as the superficial artery but a little lower down.

Other small twigs from the femoral and its branches are seen at the lower part of the dissection.

The veins of this region all enter the *internal saphenous vein*, *a*, and by means of it their blood is conveyed to the femoral vein.

FIG. 2.

This dissection was made from the last by reflecting the several parts of the deep layer of the superficial fascia. An oblique incision was carried downwards and inwards from the middle of the upper incision in the skin as far as the scrotum, and the two flaps of the fascia over the abdomen, †, †, were thrown upwards and downwards, thus exhibiting its attachment to the fascia lata below Poupart's ligament. The cribriform fascia, *, was then carefully turned inwards and separated at the same time from the margins of the saphenous opening.

In the thigh, the fascia lata with the saphenous opening and the inner part of the sheath of the vessels were then

exposed, but as they will be better understood after examining the following Plate, their description will be for the present postponed.

MUSCLES.

The *aponeurosis of the external oblique*, as seen in this region, presents a glistening surface with fibres passing for the most part downwards and inwards, but crossed by a few superficial ones which take an opposite direction. A shallow depression runs upwards and outwards from the pubes, marking the position of the outer edge of the rectus muscle. The aponeurosis ends below in a strong rounded band of fibres, *Poupart's ligament*, which passes, in a slightly curved direction, from the anterior superior spine of the ilium to the spine of the pubes. The convexity of this curve is downwards, but as the fascia lata of the thigh is firmly attached to the ligament, the shape of the latter is liable to a certain amount of alteration from changes in position of the limb—*e.g.*, any movement of flexion or adduction of the thigh, which renders the fascia less tense, will allow Poupart's ligament to become less curved. The inner end of Poupart's ligament is attached to the inner part of the ilio-pectineal line, by means of a flat triangular band of fibres called *Gimbernat's ligament*, the plane of which in the erect position of the body is almost horizontal. Of its three borders, one is attached to Poupart's ligament, one to the ilio-pectineal line, and the other is free and looks towards the crural canal. At the lower and inner part of the aponeurosis is a somewhat triangular opening, the base of which is downwards at the pubes, while the apex is directed upwards and outwards. This is the *external abdominal ring*, which is in reality an interval between some of the oblique fibres of the aponeurosis. Its inner border is sharp, and the fibres forming it if traced forwards are found to end on the front of the pubes, where they decussate with those of the opposite side. The outer or

border is formed by Poupart's ligament. The apex is stated by means of the superficial cross fibres mentioned, which are called *intercolumnar*, from the manner in which they bridge across the interval between the margins, or *pillars*, of the ring. These fibres appear sometimes to be prolonged from the aponeurosis of the opposite side. The external ring may easily be felt, if the little finger be passed up under the skin of the abdomen by invaginating the loose skin of the scrotum; it is then to be found that these intercolumnar fibres give to the ring an altogether rounded form, and completely obliterate the triangular shape which we are accustomed to see in the operating-room. At Plate 20, Fig. 1, †, a triangular band of the *triangular fascia*, exposed by removing the aponeurosis of the external oblique is seen, lying on the anterior part of the insertion of the internal oblique. This band seems to be a prolongation of some of the deep fibres of the aponeurosis of the opposite side, which pass down to the ilio-pectineal line. The *cremaster*, B, is in part exposed, appearing through the external abdominal ring. It will be better seen in the next

NERVE.

The *crural branch of the genito-crural*, 3, which was not visible in the last drawing, is now visible.

PLATE 20.

FIG. 1.

THE preparation of this dissection from such a one as the last, was made, by reflecting downwards the aponeurosis of the external oblique in the following manner :—A horizontal incision, immediately below that in the skin, was carried inwards until the point was reached where the aponeurosis of the external oblique became continuous with that of the internal oblique; and another passed obliquely downwards and inwards towards the pubes, along the line of junction of these two aponeuroses. The remains of the deep layer of the superficial fascia, and the spermatic fascia, were cleared away from the cremaster muscle.

Two cuts were made in the fascia lata of the thigh, one vertically downwards, immediately outside the saphenous opening, for about two inches, and another outwards from the upper end of the last, parallel with Poupart's ligament for a somewhat greater distance. The parts exposed—viz., the outer part of the sheath of the vessels and the anterior crural nerve—were then cleaned by removing some areolar tissue, and a little of the fascia covering the latter.

The *fascia lata* at the upper part of the thigh is attached, outside the region known as Scarpa's triangle, to the crest of the ilium, and inside it to the ramus and symphysis of the pubes. In this particular region, however, though remembering the fact that it is throughout continuous, we may consider the fascia as if consisting of three parts. One, ¶, lies over the pectineus and adductor longus, and is attached above (*vide* Plate 18) to the ilio-pectineal line, outside Gimbernat's ligament. It passes outwards over the pectineus to the line of attachment of the muscle—viz., the line leading from the small trochanter to

the linea aspera, and thus lines the inner wall of the hollow pyramid forming Scarpa's triangle. Another passes downwards over the psoas and iliacus muscle, being continuous with the special fascia of these muscles as far as their line of attachment, which is again the small trochanter and the bone below it; this layer lines the outer wall of Scarpa's triangle. Lastly, there is a superficial portion, bridging over the contents of the triangle, and thus forming its roof or third side, continuous at the two sides with the pieces before described, and attached above to Poupart's and Gimbernat's ligaments. At the extreme upper and inner angle of this part of the fascia there is an opening, which, as a result of its position, has an outer sharp border, while its inner side is bounded by the piece of fascia first described, or rather it has no border at all. This, the *saphenous opening* (see also Plate 19, Fig. 2), is oval in shape, $1\frac{1}{2}$ inch long, and $\frac{3}{4}$ inch wide, the long axis being directed downwards and outwards, and the central part of the opening being at a distance of about $1\frac{1}{2}$ inch outside and below the spine of the pubes. The outer sharp border ends above at Gimbernat's ligament, and below disappears on the inner part of the fascia lata; this border is firmly attached to the cribriform fascia. The opening transmits the saphenous vein and the superficial external pudic artery, as well as numerous lymphatic vessels. Projecting through it is seen the inner part of the crural sheath, †, with the vein showing through. The part of the fascia lata outside the opening is conventionally called the *iliac portion*, that inside it the *pubic portion*.

By comparing this drawing with Fig. 2 and with Plate 18, an idea will be obtained of the nature of the crural sheath. This is a conical or funnel-shaped sheath of fascia inclosing the femoral vessels. Its length is about two inches; its apex is downwards; the outer margin is vertical, the inner oblique. Its anterior portion, though attached to Poupart's ligament, is directly continuous beneath it with the fascia transversalis. Its posterior portion is continuous with the fascia iliaca above

the level of Poupart's ligament.* This funnel is divided into three compartments, Fig. 2:—an outer for the artery, a middle one for the vein, and an inner one, containing a lymphatic gland and some areolar tissue, to which the name of *crural canal* is applied. The sheath blends below with the common arterial sheath. It is perforated at the outer side by the crural branch of the genito-crural nerve, 3. The crural canal is thus very short, but is said to be three-quarters of an inch in length. It has outside it the compartment of the sheath which contains the femoral vein, behind it the fascia over the pectineus, in front of it the fascia lata and Poupart's ligament, and internal to it for a short distance, Gimbernat's ligament. Its upper opening, the *crural ring*, is closed by some sub-peritoneal fat known as the *septum crurale*.

The *triangular fascia*, †, is described at p. 189.

MUSCLES.

Internal oblique, B.—The part of this muscle here seen consists of fibres, of which the upper ones pass almost horizontally, while the others run downwards and inwards, forming an arch which extends from the middle of Poupart's ligament to the ilio-pectineal line. These lower fibres unite with those of the transversalis muscle in the conjoined tendon, to be afterwards described; the upper ones end in an aponeurosis which blends with that of the external oblique.

Below the internal oblique is the thin muscular layer of the *cremaster*, C, which is continuous with its lower border as well as with that of the transversalis. This small muscle is attached externally to Poupart's ligament and internally to the front of the pubes and the conjoined tendon. The fibres pass down into the scrotum surrounding the testicle. Its action is to draw the testicle upwards.

* The connexion between the two is often very slight, the sheath being separable from the fascia iliaca as far as the ilio-pectineal line, to which both are firmly attached.

ARTERIES.

The small *cremasteric* branch of the epigastric, *d*, is now seen running down in the cremaster muscle.

NERVES.

The *ilio-hypogastric*, 4, and *ilio-inguinal*, 5, have been uncovered, as they run forwards between the two superficial muscles of the abdomen.

The *anterior crural*, 1, lies immediately outside the sheath of the vessels.

FIG. 2.

This dissection was made from one carried to the same point as the last, by removing the internal oblique and cremaster muscles. A horizontal incision was made in the former below that in the external oblique, as far as the line where its aponeurosis unites with that of the subjacent transversalis; and another was carried obliquely downwards and forwards, so as to divide its origin from Poupart's ligament. The muscle was then turned inwards, while the cremaster was taken completely away. The dissection in the scrotum had not been carried so deeply.

In the thigh, the so-called iliac portion of the fascia lata was removed, and the three compartments in the sheath were opened so as to display their contents.

Beneath the transversalis muscle appears the *fascia transversalis*, †, giving a tubular prolongation over the spermatic cord. Through the fascia is seen the epigastric artery, with its accompanying veins.

The *spermatic cord* runs inwards, and slightly downwards, from a point immediately over the artery to the inner side of the pubic spine. It occupies the inguinal canal, to be presently described.

MUSCLES.

The *transversalis*, C, in this region, has an appearance very similar to that of the internal oblique, and its fibres take almost the same directions, though they do not extend so far internally. Here it ends in an aponeurosis, which is continuous with the posterior surface of that of the internal oblique. Below, it forms an arch reaching from the outer third of Poupart's ligament to the ilio-pectineal line, where it ends in a flat tendon an inch broad, the inner part of which is common to the transversalis and internal oblique muscles. This, the *conjoined tendon*, is almost vertical in position, and lies behind, and slightly to the inner side of, the cord; whereas Gimbernat's ligament, which is attached to the same line, is almost in the horizontal plane, and lies underneath the cord. The conjoined tendon is covered to a greater or less extent by the triangular fascia.

The *inguinal canal* is a space, one inch and a half long, passing between the structures forming the abdominal wall, through which the cord leaves the abdomen. It begins at the internal abdominal ring, which is situated about half an inch above Poupart's ligament, immediately over the femoral artery,* and below the arch formed by the transversalis muscle. The anterior wall of the canal is formed by that part of the internal oblique which is below the transversalis, and by the aponeurosis of the external oblique; the posterior wall, by the fascia transversalis, the conjoined tendon, and, if it be wide enough, by the triangular fascia. The floor of the space is formed principally by Poupart's and Gimbernat's ligaments; the roof, if one can be described at

* There are two guides to the surface marking of the internal ring. 1st. A line drawn vertically upwards for half an inch above a point midway between the symphysis pubis and the anterior superior spine; and 2nd. A line drawn for the same distance from the middle of Poupart's ligament and at right angles to it. The epigastric artery, it will be remembered, is directed at first slightly inwards, and afterwards ascends internal to the ring.

all, by the lower fibres of the transversalis and internal oblique muscles.

The herniæ which descend in this region may be of three kinds ; in the first place, the simple *oblique* hernia which follows the course of the cord ; and, in the second two varieties of *direct* herniæ, or those which make their way through the abdominal walls internal to the position of the internal abdominal ring. The direct hernia may descend only into the inguinal canal, when it is called a *bubonocoele*, but if it pass further it is guided by the deep layer of the superficial fascia (p. 185), into the scrotum or labium. It will thus be provided with coverings corresponding to all the structures it has passed through—viz., the peritoneum or sac ; the subperitoneal fat ; the fascia transversalis ; the cremasteric fascia, or dilated fibres of the cremaster muscle ; the spermatic fascia, or that which is derived from the intercolumnar fibres ; the two layers of the superficial fascia, and the skin. If, however, it have made its way internal to the internal abdominal ring, it may occupy one of two positions—i.e., it may pass through the conjoined tendon, or it may enter the canal just external to this. In the latter case it is indistinguishable from an oblique hernia, and has the same coverings, but the epigastric artery is to the outer side of its neck, a point which it is important to remember in making the incision for the division of the stricture in strangulated inguinal hernia. If the rupture have passed through the conjoined tendon, it may be supposed to receive a covering from this instead of from the cremaster muscle ; but this hernia results usually from a sudden strain, in which case the tendon is not dilated, but more or less torn. The diagnosis of the direct from the oblique hernia, depends upon the fact that the neck of the former does not extend up in the direction of the internal ring ; and also that if it be reduced, pressure upon the internal ring does not prevent its redescent. The truss for a direct hernia must accordingly be applied directly over the external ring, while that for the oblique kind must

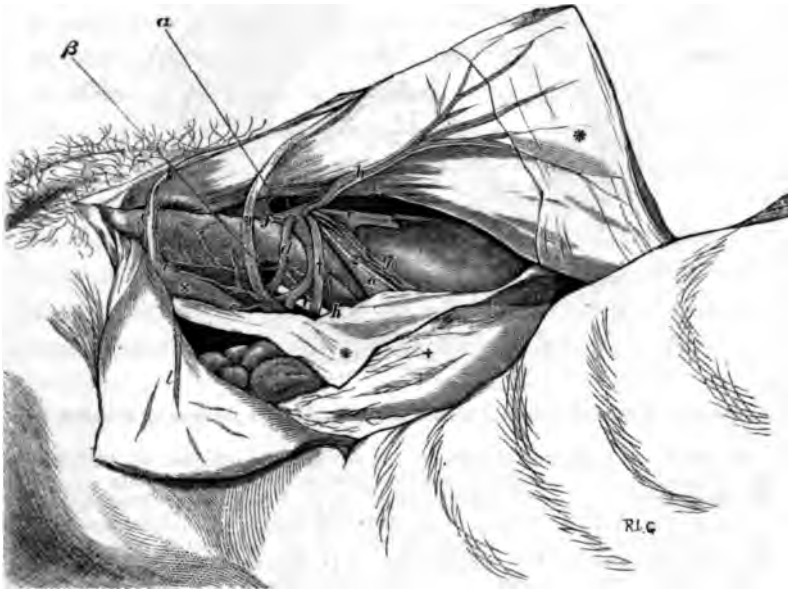
exert its influence over the whole of the inguinal canal. In operating for the relief of a strangulated inguinal hernia the skin is pinched up over the neck of the sac, and transfixed, in such a way, that the incision may be parallel with the inguinal canal. The knife is then carried carefully through the various investing layers until the sac is reached, when the stricture, if found to be outside it, may be divided without opening the peritoneum. If this cannot be done, the sac is opened, the seat of stricture discovered, and the band is divided by cutting vertically upwards, as by such a method there is least likelihood of wounding the epigastric artery. The stricture may occur at the internal abdominal ring, beneath the internal oblique, or at the external ring.

An inguinal hernia, as a rule, passes down in front of the spermatic cord, and the testicle is usually found at the lower and posterior part, even in the case of a large hernia. The relation of the hernia to the testis depends, however, upon the condition of the tunica vaginalis; thus if the communication between this cavity and the peritoneum remain permanent, the intestine descends round the testicle, which thus appears as if inclosed in the swelling. This variety of hernia is called *congenital*, though it frequently does not make its appearance before adult life. If the tunica vaginalis remain patent almost as far as the external ring, the sac may project into it. This constitutes the variety known as *infantile* hernia, in which form the gut is not only surrounded by its own peritoneal covering, but also by two layers of tunica vaginalis.

A *femoral hernia* descends through the crural canal, and receives as it passes downwards, the following coverings: the sac of peritoneum, the subperitoneal fat or septum crurale, the crural sheath, the cribriform fascia, the superficial layer of the subcutaneous fascia and the skin. After emerging through the saphenous opening it is directed upwards and inwards, this course being dependent upon the more firm attachment of the superficial fascia to the fascia lata, below than above. It passes then in a

direction very nearly parallel with that in which an inguinal hernia descends; and it thus happens that a small inguinal, may easily be confounded with a femoral, hernia. The diagnosis depends upon the fact that the pubic spine is external to the neck of an inguinal, but internal to that of a femoral hernia.

The common point of strangulation is Gimbernat's ligament,



View of Internal Abdominal and Crural Rings from Inside.

ARTERIES.—*a*, External iliac. *b*, Epigastric. *c*, Deep circumflex iliac. *d*, *e*, *f*, Superior vesical. *g*, Pubic. *h*, Spermatic. *i*, Artery to vas deferens. *j*, Internal abdominal ring. *k*, Crural ring. *l*, Obliterated hypogastric artery. *m*, Vas deferens. *n*, Bladder. *o*, Urachus. *p*, *q*, Peritoneum. *r*, Great omentum.

but it may be met with beneath the deep crural arch (p. 172) or at the saphenous opening. The relation of vessels to the crural ring (*see* woodcut) has an important bearing upon the question of the direction in which the stricture of the gut is to be divided. The femoral vein is to the outer side, and the spermatic cord and the small pubic branch of the epigastric in

front. Thus the ring has vessels in front and externally, and as the bone is behind, the only direction in which it is safe to use the knife is inwards. The incision is usually made inwards and upwards, as by so doing not only Gimbernat's ligament, but Poupart's ligament and the edge of the saphenous

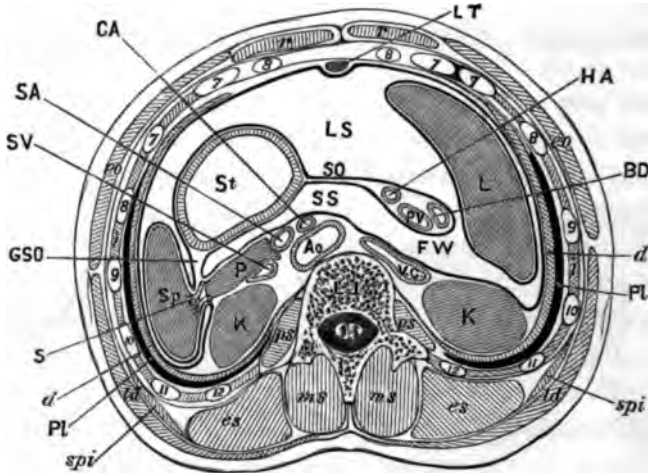


*Diagram of Section through Abdomen at the Level of the foramen of Winslow.**

MUSCLES. *r, r*, Rectus abdominis. *eo, eo*, External oblique. *ld, ld*, Latissimus dorsi. *spi, spi*, Serratus posticus inferior. *i, i*, Intercostals. *ea, ea*, Erector spinae. *ms, ms*, Multifidus spinae. *ps, ps*, Psoas. *d, d*, Diaphragm. *Ao*, Aorta. *V C*, Vena cava. *C A*, Coronary artery. *S A*, Splenic artery. *S V*, Splenic vein. *S*, Splenic vessels cut as they enter the spleen. *H A*, Hepatic artery. *P V*, Portal vein. *B D*, Bile duct. *L*, Liver. *St*, Stomach. *K, K*, Kidney. *Sp*, Spleen. *P*, Pancreas. *F W*, Foramen of Winslow. *L S*, Large sac. *S S*, Small sac. *S O*, Small omentum. *G S O*, Gastro-splenic omentum. *Pl*, Pleura. *L T*, Ligamentum teres.

L 1, 1st Lumbar vertebra. *12, 11, 10, &c.*, successive ribs.

nous opening are all divided. The obturator artery not unfrequently springs from the epigastric instead of from the internal iliac, in which case it may either pass downwards into the pelvis between the vein and the crural ring (*see woodcut, p. 197*), or, as occurs more rarely, it may arch round the ring and pass downwards upon its inner side. If this condition exist the

* For the description *see p. 167*. Owing to a clerical error the reference is there made to *p. 178* instead of *p. 198*.

ring is completely surrounded by vessels; and should it coexist with a femoral hernia which happens to become strangulated, the danger of wounding the obturator is very great. If such an accident occur, the hæmorrhage may take place into the peritoneal cavity if the sac have been opened, or if it have not been opened into the subperitoneal connective tissue. The treatment must consist either in attempts to secure the vessel before or after enlarging the wound, which is a task of very considerable difficulty; or else in applying a carefully arranged graduated compress, the deepest part of which should be soaked in some astringent material, and applied as accurately as possible to the seat of the injured vessel.

In attempting the reduction of either an inguinal or a femoral rupture, it is of importance to recollect the direction of the openings by which they descend, in order that pressure may be applied in the most advantageous manner. The thigh should be flexed, adducted and rotated in, as this position relaxes most thoroughly the fascia lata and Poupart's ligament.

PLATE 21.

FIG. 1.

THIS drawing represents the ordinary dissection of the perinæum. It was prepared by reflecting a square piece of skin, the limits of which were as follows:—a line drawn horizontally for three inches on each side of the coccyx, another parallel with it and of equal length midway between the anus and the scrotum, and two others by which the extremities of the first two were joined.

On the left side the superficial layer of the superficial fascia was taken away, exposing the deep layer of the same fascia and the fascia lata of the thigh. At the back of the dissection the contents of the ischio-rectal fossa were cleared away in order to expose the muscles. On the right side all the superficial fascia was removed, and the muscles, vessels and nerves, as far as they were exposed, were cleaned.

The *superficial layer of the superficial fascia*, which has been removed, is directly continuous with that in the adjoining parts. It contains, like the superficial fascia in other parts of the body, a variable amount of fat, which extends into and fills the ischio-rectal fossa, at the posterior part of the perinæum; but on the scrotum the fat is replaced by involuntary muscular fibre, and here the name of *dartos* is applied to it.

The *deep layer of the superficial fascia* (Figs. 1, 2, and 3), to which reference has been made before (p. 185), is thin and membranous, and is attached along the pubic arch and the base of the triangular ligament. It thus forms a pouch, closed behind, of a somewhat triangular shape, the base of the triangle being directed backwards. By removing the fascia of one side, it may be seen that this pouch is divided into two lateral parts by a median septum which reaches forward into the scrotum.

This division may be also demonstrated by inserting a blowpipe under the fascia on one side, and inflating it. It will then be found that one half of the pouch is first inflated; but when the air has reached the scrotum it passes over into the other side, and after distending this until the swelling in the perinæum has become symmetrical it passes forward over the penis and the lower part of the abdominal wall (p. 186). A similar appearance is presented if urine be extravasated beneath the fascia, as a result of rupture of the membranous part of the urethra; or, if an abscess, from any cause, occupy this situation.

This fascia is intimately connected along the symphysis pubis and pubic arch with the *fascia lata* over the gracilis and adductor magnus, ¶, and behind, along the ischial tuberosity, with the obturator fascia.

MUSCLES.

The *gluteus maximus*, A, is in part seen forming the posterior boundary of the perinæum. It is tendinous at its origin from the coccyx, but coarsely fasciculated elsewhere.

The *sphincter ani externus*, C, is a thin muscle, the fibres of which surround the anus. It is fixed in front to the central point of the perinæum, and behind to the tip of the coccyx; but both in front and behind, its attachment is widened by fibres which are lost in the superficial fascia. The fibres of the levator ani blend with it near the anus. In the course of dissecting the ischio-rectal fossa the muscle loses the support derived from the fat which this space contains, and it accordingly appears after dissection to be much narrower than it really is.

The action of the muscle is to close the anus. It is usually in a state of tonic contraction, but can be made to act more forcibly under the influence of the will.

The *internal sphincter*, E, is a pale ring of involuntary muscular fibres, surrounding the anus within the external

sphincter. It is in direct continuation above with the circular fibres of the gut. Its action is wholly involuntary. It is mostly in a state of tonic contraction, but is subject to variations, often rhythmical, in the amount of this contraction, which depend upon the reflex irritation produced by fæces or foreign bodies in the rectum.

The *corrugator cutis ani* (Ellis), D, here represented rather too distinctly, is a thin layer of pale muscular fibres radiating from the anus over the internal and external sphincter muscles.

The three superficial muscles of the anterior part of the perinæum are better seen in Fig. 2, but they will be described here.

The *superficial transverse muscle*, F, arises from the inner side of the tuberosity of the ischium, and passes inwards and slightly forwards to be inserted into the central point of the perinæum, in common with its fellow of the opposite side, the external sphincter, and the ejaculator urinæ. It thus renders the central point more fixed.

The *ejaculator urinæ*, H, covers the bulb of the urethra; it consists of two parts, which are joined to one another in the middle line. It arises from a median raphé. The posterior fibres are inserted on the front of the triangular ligament; those in the middle which form the greater part of the muscle surround the bulb and meet on its upper aspect, while the most anterior pass over the corpus cavernosum to be inserted on the side of the penis. The muscle acts voluntarily to expel the last few drops of urine, involuntarily in the emission of the semen. It serves to limit the extent of some perineal abscesses in the following way: matter which has collected subacutely in connexion with a stricture or a false passage is often seen to make its way forwards as far as the anterior border of the ejaculator urinæ, and then to point through the skin.

The *erector penis*, G, is a long muscular band placed upon

the crus penis. It is attached further back than the superficial transverse muscle to the tuber ischii and the arch of the pubis on each side of the crus. It ends in a fibrous expansion which is inserted into the crus at its under and outer part. By its contraction it compresses the crus, and is thus supposed to aid in causing or maintaining erection of the penis.

ARTERIES.

Two branches of the internal pudic, the *inferior hæmorrhoidal*, *a*, *b*, and the *superficial perineal*, *c*, are seen in this stage of the dissection. They will be described in connexion with Plate 23, p. 216.

NERVES.

The *inferior hæmorrhoidal*, 1, and the *superficial perineal*, 5, which are derived from the perineal branch of the internal pudic, will be described at p. 217.

Some small twigs derived from the lowest sacral nerves appear near the coccyx. One, 3, which is close to the side of the coccyx, is formed *by the union of part of the anterior primary branch of the fourth, with the whole of that of the fifth sacral and the sixth sacral or coccygeal nerve*; another, 4, is the *hæmorrhoidal branch of the fourth sacral*.* The former appears below the gluteus maximus, and runs forward to the tip of the coccyx; the latter either pierces the levator ani or passes between this and the coccygeus, and is distributed to the external sphincter and the integuments behind the anus. There are, besides, one or two branches winding round the *gluteus maximus*, 2, derived usually from the anterior branches of the third or fourth sacral or both these nerves.

The *inferior pudendal*, 6, a branch of the small sciatic, pierces the fascia lata about an inch in front of the ischial

* In the process of lithography this nerve has been very indistinctly represented.

tuberosity, and runs forward to the scrotum, where it communicates with one of the superficial perineal nerves.

The word *perinæum*, in surgical language, is often confined to the interval between the anus and the scrotum, or the anus and the vulva; but for the anatomist it describes a region which is limited by the following deep boundaries: in front the apex of the pubic arch, behind the coccyx, and laterally the rami of the pubes and ischia, the tuberosities of the ischia and the great sacro-sciatic ligaments covered by the great gluteal muscles. These boundaries inclose a diamond-shaped space which is divided into two parts by a transverse line drawn across in front of the ischial tuberosities. The anterior contains the crura of the penis, the bulb of the urethra and the triangular ligament with the structures in connexion with it, while the posterior includes the two ischio-rectal fossæ, with the lower end of the rectum intervening between them. The distance between the ischial tuberosities is about three inches, and that between the coccyx and the arch of the pubis about four inches.

The *ischio-rectal fossa* is the space on each side of the lower end of the rectum. It is of an irregular wedge-shape, the base of the wedge directed downwards. The outer wall is straight, and is formed by the perpendicular part of the pelvic fascia (obturator), below the level at which it splits; the inner wall is oblique, and is formed by the levator ani and coccygeus, and partly by the sphincter ani, the levator being covered by its own special, or anal, fascia. The space is about an inch wide. It is much deeper behind than in front, measuring in the former situation about two inches in depth, in the latter not more than about an inch. The fossa is filled by a quantity of loose fat in which ramify branches of the internal pudic vessels and nerves.

The incision in *lateral lithotomy* passes through the ischio-rectal fossa (p. 211). The space is also interesting to the surgeon, as affording an example of one of the large cellular intervals,

in which an abscess may burrow until it has reached a considerable size before pointing on the surface. The commonest form of abscess to occur in the ischio-rectal fossa is that which ultimately results in a *fistula in ano*. Such abscesses may either originate in the fat of the fossa and burst both into the rectum and on the surface, in which case the fistulous track passes above the sphincter muscles; or, as is by far the most common condition, they may originate as sub-mucous abscesses in the bowel, and then pass internally to the sphincter muscles into the ischio-rectal fossa. In the latter case, the abscess consists of two sacs separated by a constriction, and if the outer part make its way to the skin and discharge itself, the inner one is still left with an insufficient opening, and probably, as a consequence, will open into the bowel. The operation for the cure of a fistula in ano consists in laying open the sinus into the bowel; and it is obvious, that if the first of the two conditions described be that which is present, the sphincter ani will be divided in the incision, whereas if the latter be that which have occurred, the knife will only pass through the skin and mucous membrane more or less thickened by inflammation.

A third way in which fistulæ may arise, is as a result of disease of the rectum at some distance from the anus—for example, in cases of simple or malignant stricture, under which circumstances the track will pass outside the sphincter.

FIGS. 2 AND 3.

Figs. 2 and 3 represent the anatomy of the anterior part of the perineal space, and may fitly be described together. In making the dissection for Fig. 2, the skin was removed from the back of the scrotum, and the vessels and nerves were traced further forwards on the right side. On the left, the vessels and nerves were disregarded, in order to display the muscles more clearly, and the deep layer of the superficial fascia was removed

to a greater extent than on the right side. In Fig. 3, the dissection on the left side was untouched, except that the ejaculator urinæ and transverse muscles were removed; on the right side, the superficial vessels and nerves were taken away, with more of the deep layer of the superficial fascia; the ejaculator urinæ and transverse muscles were removed; the crus penis was separated from its attachment to bone, and the anterior layer of the triangular ligament, which was thus fully exposed, was taken away. The parts which occupy the interval between the layers of the ligament were then cleaned.

The *triangular ligament* consists of two layers of rather thin fascia, separated by a narrow interval, and occupying the upper part of the pubic arch. The posterior layer, at its attachment to the bone, may be said to be continuous with the obturator fascia, while at the spot where it is perforated by the urethra, it is also continuous with that part of the recto-vesical fascia which forms the sheath of the prostate. The two layers are continuous with one another at the base of the ligament, and here also the deep layer of the superficial fascia is attached to them. The base forms an arch with a double span, for after rising on each side from the ramus of the ischium, it dips down in the middle line to reach the central point of the perinæum. In contact with the front of the anterior layer are the bulb of the urethra and the ejaculator urinæ, the crus penis and the erector penis, and the superficial transverse muscle. In contact with the back of the posterior layer (*see* Plate 22, Fig. 1) are the levatores ani, the apex of the prostate, and the fat which occupies the interval between the anterior true ligaments of the bladder. Between the two layers are the deep transverse muscles and the constrictor urethræ, the pudic vessels and nerves with their terminal branches and the important artery to the bulb, the membranous part of the urethra, the glands of Cowper, the sub-pubic ligament, the dorsal vein of the penis, and some areolar tissue.

MUSCLES.

The *deep transverse muscle*, Fig. 3, F, arises from the arch of the pubes behind the superficial transverse muscle, and is inserted into the central point of the perinæum. Its action is to fix the central point of the perinæum.

The *constrictor urethræ*, Fig. 3, G, is a thin band of muscular fibres arising from the arch of the pubes above the last muscle, and passing across to a corresponding point on the opposite side; the fibres split as they approach the middle line so as to enclose the membranous part of the urethra. By their contraction they compress this part of the urethra.

ARTERIES AND NERVES.

The general description of the pudic artery and nerve will be found at pp. 216 and 217. It may here be mentioned that they pierce the posterior layer of the triangular ligament, and that they lie close to the bone behind the crus penis, the nerve being at last slightly outside, or above, the artery. The nerve may give off, as in this case, a slender branch to the corpus cavernosum. The artery, which is accompanied by venæ comites, gives off small branches to the crus, and generally the large artery of the bulb, and it divides in front into the dorsal artery of the penis and the artery of the corpus cavernosum.

PLATE 22.

FIG. 1.

THIS dissection illustrates the parts which are exposed by the complete removal of the triangular ligament. It was prepared from that shown in the Plate 20, Fig. 3, by separating the left crus penis from the pubic arch, and the bulb of the urethra from the triangular ligament, and turning both of them upwards; then by removing the anterior layer of the triangular ligament on the left side, and afterwards clearing away all the structures which lie between the two layers. Lastly, the posterior layer of the ligament was removed, and the parts exposed by its removal were cleaned.

MUSCLES.

The preparation shows the manner in which the anterior fibres of the *levator ani*, A, which arise from the back of the pubes (p. 215), and are also attached to the back of the triangular ligament, pass almost vertically downwards and unite with the corresponding fibres of the opposite side beneath the prostate (*levator prostatae*).

VEIN.

The large dorsal vein of the penis receives the blood from the parts supplied by the dorsal artery of the penis. It begins as two branches supplied by tributaries which come from the glans penis, they soon unite into one trunk, which runs up the dorsal groove on the penis, and receives branches from the skin as well as the corpora cavernosa and spongiosum. It pierces both layers of the triangular ligament and divides into two parts, which pass one on each side of the prostate, and empty themselves into the large prostatic plexus.

FIG. 2.

This drawing represents a section made, after freezing, through the pelvis of a well-developed adult man, not exactly in the middle line. An attempt was made to carry it in the plane of the lithotomy wound, but this was only partially successful. A difficulty, which had been foreseen, was actually experienced, resulting from the fact that the deep incision in lateral lithotomy is more oblique than the superficial one. The plane of this section corresponds to that which is followed by the knife in the first incision, but the prostatic portion of the urethra was not reached, and it was necessary to open it afterwards. The saw passed through the cartilage of the symphysis pubis, just shaved the left side of the rectum in the second part, but missed it in the first part, and divided the left side of the upper part of the sacrum, catching at the same time a portion of the ilium. If the object of the section had been completely attained the sacrum would have been cut to the right of the middle line, and the rectum would have been *divided* in the first portion.

The section illustrates a point in the anatomy of the rectum which will be again referred to—viz., that the first part is inclined from the left to the middle line, and often passes slightly to the right side; at the commencement of the second part the bowel returns to the middle line, and continues in this position to the anus, or is slightly inclined to the left side. As a result of this there are two very gradual lateral curves—the lower, with its convexity to the left, and the upper, with its convexity to the right. The antero-posterior curves are also now apparent, that in the first portion having its convexity forwards, the second corresponding to the hollow of the sacrum, having its convexity backwards, and the third close to the anus, having its convexity again forwards. It will be found of some service to remember these curves in passing a long tube or bougie into the rectum. If this be bent at the

end, and introduced with the convexity forwards, a simple movement of rotation from left to right, through half a circle, will cause the instrument to follow all the curves of the rectum as far as the promontory of the sacrum.

An idea can be gained from this drawing of the extent of the recto-vesical pouch, and of the propriety of tapping the bladder through the rectum. The pouch reaches in most cases as far as the back of the *trigone* of the bladder—i.e., as far as the tip of the *vesicula seminalis*, *v.* The interval, therefore, between the back of the prostate and the tip of the *vesicula*, is usually a safe one for puncturing the bladder by the rectum. But it must be remembered that the arrangement of the peritoneum is liable to considerable variation. I have at least on two occasions seen the recto-vesical pouch extending up to the prostate.* In many of the cases in which this operation is recommended, the prostate is enlarged. This greatly increases the difficulty, as the finger, which is to be used as the guide for the trocar, may, under such circumstances, be unable to reach the point at which the puncture has to be made.

The comparatively large amount of cellular tissue behind the pubes, above the apex of the bladder, renders it possible to puncture the viscus in this situation with comparative safety to the peritoneum, even when the bladder is undistended. But if the bladder be full or over-distended, and have risen above the pubes in front of the peritoneum, an instrument may be passed into it without fear of wounding the peritoneum. At the same time it must not be forgotten that the tissue that is traversed is the cellular tissue of the pelvis, and that leakage of putrid urine into this will be followed by pelvic cellulitis, which exposes the patient to almost as great a risk as a wound of the peritoneum itself.

* One was a case in which puncture of the bladder had been performed in the orthodox manner, and in which the instrument had, of course, entered the peritoneum.

The structures divided, or in danger of division, in the operation of *lateral lithotomy* may be observed in this and the preceding Plate. The first incision is made by entering the knife, near the middle line, at a distance of from an inch to an inch and a half in front of the anus, (or proportionally less in the infant), and carrying it downwards and outwards to a point midway between the ischial tuberosity and the anus. At the anterior part the point of the knife is passed slightly forwards and inwards, and introduced sufficiently deep to open the interval between the layers of the triangular ligament, just behind the bulb of the urethra, avoiding in this way the artery of the bulb (Plate 21, Fig. 3, *b*), unless this vessel leaves the pudic further back than usual. The posterior part of the incision is, on the other hand, shallow. The structures actually divided are the fat of the ischio-rectal fossa, with branches of the superficial perineal and inferior hæmorrhoidal vessels and nerves, the superficial transverse muscle and transverse artery, the base of the triangular ligament and the deep transverse muscle, and perhaps a few fibres of the levator ani. The structures to be avoided are the artery of the bulb, the pudic artery, and the rectum.

In the deep incision the knife is made to enter the groove of the staff by dividing the membranous part of the urethra; it is then lateralised and pushed on in the groove of the staff till it enters the bladder. In so doing the structures divided are the membranous urethra and some fibres of the levator ani, if not previously cut, the prostate and its surrounding veins, and the neck of the bladder. The dangers in this stage of the operation (excluding such as arise from leaving the staff, &c.) consist in cutting too far backwards, so as to wound the rectum, or too far outwards, and so injuring the recto-vesical fascia at the point where it is giving off the sheath of the prostate. The latter accident is more liable to occur in the process of extracting the stone, and it should be observed, that, while the special capsule of the prostate, and the

sheath derived from the recto-vesical fascia, may be, as indeed is frequently the case, cut or torn without opening up the cellular tissue of the pelvis, it is only injury of the recto-vesical fascia itself, at the spot indicated, which is liable to be followed by pelvic cellulitis.

This drawing also illustrates the curve of the urethra, indicating the direction in which an instrument must be passed for its safe introduction into the bladder; the necessity for depressing the end which is held in the hand after the beak has entered the prostatic portion, and the danger of so doing at an earlier period. If this depression be made too soon, the beak of an instrument with a short curve, such as a lithotrite or sound, may be pushed up in front of the prostate, under which circumstances it will be liable to pass through the recto-vesical fascia, in the interval between the anterior true ligaments of the bladder, and thus into the cellular tissue of the pelvis.

PLATE 23.

FIG. 1.

This dissection is the first of a series which illustrates the appearances seen in a side view of the pelvis.

It was made by carrying an incision through the skin and soft parts along the following lines:—From the posterior to the anterior superior iliac spines along the iliac crest; from the anterior superior spine to the pubic spine along Poupart's ligament; then along the outer part of the symphysis pubis and rami of pubes and ischium, and over the ischial tuberosity to the posterior superior spine again. All the soft parts were cleared away from the bones included by these incisions, and the femur was disarticulated and removed.

The peritoneum was then separated from the psoas and iliacus muscles and the external iliac vessels, until the brim of the pelvis was reached. The upper attachment of the pelvic fascia to the ilio-pectineal line was divided. The knife was afterwards passed upwards internal to the tuberosity and ramus of the ischium, so as to detach from them the great sacro-sciatic ligament and the pelvic fascia. Afterwards the hip-bone was sawn through from a point close to the anterior inferior spine, into the middle of the great sacro-sciatic notch; and again vertically through the pubes immediately inside the obturator foramen. The ischial spine was then chipped off, and the portion of the hip-bone separated by the incisions was taken away, the attachments of the obturator internus to the inner surface of the bone, and of the pelvic fascia to the back of the hip-bone, being separated at the same time.

In order to complete the dissection it only remained now to isolate and define the structures shown in section which are

covered by the gluteus maximus, and to remove the obturator internus muscle from the pelvic fascia.

There is little to be said about this drawing, beyond that which will more conveniently follow in connexion with the general description of the pelvic fascia (p. 219), and of the buttock.

The reader will notice an irregular space above the upper and inner part of the pelvic fascia as now shown, indicating the spot where the upper attachment of this fascia dips down below the notch through which the obturator vessels and nerves pass. But if the knife be carried round carefully close to the ilio-pectineal line, a strong band of fibres will be separated from the bone to which the upper part of the pelvic fascia is fixed; in which case, the vessels and nerves seem to pass through an irregular roundish opening (as in Fig. 2). The fibres of the levator ani, G, are seen more or less distinctly through the fascia.

FIG. 2.

The preparation from which Fig. 2 was taken was made from a subject in which the dissection had been carried to the same stage as in Fig. 1. The gluteus maximus, and the parts underneath this muscle, were considerably shortened, and more of the pubes and ilium were taken away, the section through the latter being nearly at right angles to that shown in Fig. 1. The lower part of the pelvic (or obturator) fascia was removed—that is to say, the part below the so-called white line (*see* p. 222), or the line from which the levator ani arises. By so doing, the cut end of the great sacro-sciatic ligament was more clearly defined, and the fat of the ischio-rectal fossa was exposed. At the same time care had to be taken of the pudic vessels and nerves, which are in close contact with the fascia, and are, indeed, enclosed in a sheath which is derived

from it. The pudic vessels and nerves, with the triangular ligament and the bulb of the urethra, were then defined, and the levator ani carefully cleaned.

It will be noticed that the ischial spine has in this preparation been drawn slightly forwards, so as to expose more completely the structures which lie beneath it, and to show the small and great sacro-sciatic ligaments.

The description of the pelvic fascia will be postponed until the next Plate is reached.

MUSCLES.

The *levator ani*, A, arises from the back of the pubes, from a line an inch or more long, which begins close to the upper part of the obturator foramen, and slopes downwards and inwards above the origin of the obturator internus as far as the anterior true ligament of the bladder, that is to within half an inch of the middle line. It also arises from the anterior part of the ischial spine; and between these bony attachments from the line where the pelvic fascia splits to form the recto-vesical p. 221). Some of the anterior fibres take origin from the back of the triangular ligament.

The anterior fibres pass down in contact with the triangular ligament, on each side of the apex of the prostate, beneath which they unite at the central point of the perinæum, and are hence called *levator prostatae*. The next set of fibres pass down on the side of the rectum, and blend with the sphincter ani. Behind these, other fibres form a sling for the lower part of the bowel, uniting with those of the opposite side in the middle line; and the last, the posterior of the series, which are very short, pass from the spine of the ischium to the coccyx, and are in contact with the anterior fibres of the coccygeus muscle. The outer aspect of the muscle is covered by a thin fascia called *anal*, derived from the pelvic fascia (obturator portion); the inner aspect is in contact with the recto-vesical fascia and the rectum. The muscle, as a whole,

helps the recto-vesical fascia to support the rectum, and so, incidentally, the rest of the abdominal viscera. It compresses and retracts the lower end of the rectum. The anterior fibres may possibly exert some influence upon the capacity of the urethra. It may be employed as an extraordinary muscle of respiration.

For the description of the sphincter ani see p. 201.

ARTERIES.

The *pudic artery, d*, is now exposed in the greater part of its course. Arising from the anterior division of the internal iliac artery, it leaves the pelvis by the great sacro-sciatic notch, piercing the fascia over the pyriformis, and receiving as it does so a sheath from this fascia (Plate 24, Fig. 1). It then rests on the ischial spine, being outside its accompanying nerve. After this it passes through the small sacro-sciatic notch, and runs forward in the ischio-rectal fossa, protected by a sheath derived from the pelvic (obturator) fascia, as far as the base of the triangular ligament. In this part of its course it is accompanied by venæ comites, and is crossed from below upwards by the nerve. It now changes its direction, and perforating the posterior layer of the triangular ligament near the base, it runs upwards between the two layers towards the pubes, when it again alters its course, and turning downwards, perforates the anterior layer of the triangular ligament to end on the anterior surface of the penis as the *dorsal artery of the penis*.

It gives off the following branches, which are also seen in the dissection of the perinæum (Plates 21, 22). The *inferior hæmorrhoidal, e*, runs transversely inwards, at the back of the ischio-rectal fossa, to supply the sphincter and levator ani, skin and fat. The *superficial perineal, f*, leaves the artery near the centre of the perinæum, and runs forward to the scrotum, over the superficial transverse muscle, giving branches to this and the other superficial muscles of the perinæum, and anasto-

ming at last with branches of the external pudic (Fig. 1, *h*). The *transverse artery* came off here, as is often the case, with the superficial perineal; it runs inwards and supplies branches to the muscles. The *artery to the bulb* (Plate 24, Fig. 2, and Plate 21, Fig. 3), leaves the vessel usually after it has pierced the triangular ligament, and runs inwards to the bulb. Its importance as regards lithotomy is explained at p. 211. At the anterior part of the space the pudic artery divides into terminal branches; the *artery to the corpus cavernosum* (Plate 21, Fig. 3), which passes outward into the corpus cavernosum, and the *dorsal artery of the penis* (Plate 21, Fig. 3), which appears on the surface of the penis, between the two parts of the suspensory ligament, and runs down on the dorsum, supplying branches to the corpus cavernosum, the skin of the penis, the glans and the prepuce.

NERVES.

The *pudic nerve*, 5, comes from the lower part of the sacral plexus. It joins the artery as it is leaving the pelvis, and accompanies it through the small sacro-sciatic notch into the ischio-rectal fossa. As it is entering this space it divides into two parts, one large *perineal trunk*, 6, and a much smaller one, the *dorsal nerve of the penis*, 9, which accompanies the pudic artery, crossing it at the anterior part of the ischio-rectal fossa, piercing the base, and then the anterior layer of the triangular ligament, and ending upon the dorsum of the penis. This part, which may be considered as the prolongation of the nerve, and is often called pudic, usually supplies no branches, but may give the nerve to the corpus cavernosum; it is distributed to the surface of the corpus cavernosum, the glans, and the integument.

The large perineal trunk, 6, gives off the following cutaneous, muscular, and genital branches. The *inferior hæmorrhoidal*, 7, begins at the back of the ischio-rectal fossa and runs inwards towards the anus. It supplies branches to the levator ani, the sphincter ani and the integument, and sends a long twig

forwards to meet with the superficial perineal and inferior pudendal nerves. The *superficial perineal*, 8, 8, are usually two in number, posterior and anterior; the former leaves the nerve first and is more superficial than the anterior. It passes over the superficial transverse muscle, while the anterior passes under it. They supply muscular branches to the superficial muscles, and cutaneous twigs to the scrotum, which unite in a plexus with those of the inferior pudendal and inferior hæmorrhoidal. The muscular branches may arise from a separate trunk which supplies the superficial as well as the deep perineal muscles. A slender nerve enters the bulb, and one may sometimes be found passing into the corpus cavernosum.

PLATE 24.

FIG. 1.

THE dissection here shown was made from such an one as the last, by taking away the levator ani, and cleaning the recto-vesical fascia, with the sheaths given by it to the rectum and prostate. These sheaths were then opened by longitudinal incisions, and the rectum, prostate, and prostatic veins were in part displayed. An incision through the deeper part of the prostatic sheath showed part of the vesicula seminalis. At the lower part of the preparation the muscles were more completely removed than in Plate 23, and the method of sawing the bone was not exactly the same. Above the obturator fascia the external iliac vessels were taken away, and the vas deferens and obliterated hypogastric artery were displayed.

In order to show a side view of the pelvis, the left side is usually chosen, because the rectum is better seen than on the right side. The subject, from which the two drawings of this Plate were made, was much smaller than those which were employed for Plate 23; the intestines, also, were less distended, so that the pelvic fascia did not bulge to so great an extent. It may be well to remark here that the number of veins shown, when the prostatic sheath is opened, is larger than that which has been figured; many were removed in order to display the prostate gland. The drawing is intended to illustrate the arrangement of the recto-vesical fascia, and thus to complete the series of views of the pelvic fascia which are obtainable in a dissection from the side.

In describing the *pelvic fascia*—i.e., the collection of fasciæ which are found in the pelvis—it is well to recognise the fact that it consists of several, more or less distinct, structures, which are, however, in many places continuous with one

another. The arrangement will therefore be more clearly understood, if the parts are first described as separate, and afterwards the manner in which they become continuous is indicated. It divides itself naturally, then, into the following:—1. The obturator fascia. 2. The fascia over the pyriformis and coccygeus muscles and sacrum. 3. The posterior layer of the triangular ligament. 4. The recto-vesical fascia.

1. The *obturator fascia* (Plate 23, Fig. 1, *) forms a close covering to the obturator internus, and is attached to bone round the origin of this muscle. Thus above it is fixed to the brim of the pelvis, and behind to the margin of the great sciatic notch; internal to the obturator foramen it follows the attachment of the muscle, and passes downwards and inwards, beneath the origin of the levator ani, to the apex of the pubic arch, below which it is attached to the rami of the pubes and ischium, the tuberosity and spine of the ischium, and the great sacro-sciatic ligament; opposite the small sciatic notch it has no bony attachment. This fascia is much strengthened along the brim of the pelvis by some strong transverse fibres (p. 214). It is to some extent continuous, along the arch of the pubes, with the posterior layer of the triangular ligament, κ , and below this with the fascia lata of the thigh. Blending with it behind is the fascia over the pyriformis and sacrum, θ . By its outer surface it is in contact with the obturator internus muscle; to the inner surface is attached the recto-vesical fascia. Above the attachment of the latter it forms part of the wall of the pelvis, and below this line, the outer wall of the ischio-rectal fossa. It supplies a sheath to the pudic vessels as they pass through the ischio-rectal fossa.

2. The fascia over the *pyriformis and coccygeus and the sacrum*, θ (Plate 23, Fig. 2, **), lines the back of the true pelvis, covering over the sacrum and the pyriformis muscle with the sacral plexus of nerves. It is attached at each side to the inner surface of the obturator fascia, and below it is continuous with the posterior part of the recto-vesical fascia. It

is perforated by the various branches of the internal iliac artery which pass through the great sacro-sciatic foramen.

3. The *posterior layer of the triangular ligament*, κ (see p. 206), is a triangular piece of fascia occupying the upper part of the pubic arch. At its attachment to the pubic arch it may be said to be continuous with the obturator fascia; behind it is directly continuous with the sheath of the prostate, to be presently described.

4. The *recto-vesical fascia* forms, together with the levator ani, an oblique diaphragm across the pelvis, attached in front to the pubes, laterally to the obturator fasciæ, and behind being fixed to the ischial spines and continuous with the fascia over the pyriformis and sacrum. Thus if, to adopt an old simile, we compare the pelvis to a room, of which the two ends are formed by the triangular ligament and the fascia over the pyriformis and sacrum, and the two sides by the obturator fasciæ, the recto-vesical fascia may be looked upon as a septum passing obliquely across it, from the junction of the anterior wall with an imaginary ceiling, to the junction of the posterior wall with an imaginary floor; while its lateral attachments are two diagonals drawn from the anterior and upper to the posterior and lower corners of the side walls. This gives, however, only an imperfect idea of the recto-vesical fascia; for it is lower at the middle line than at the sides, so as to present a considerable concavity upwards, and it supplies sheaths to the structures which are passing downwards towards the surface of the body—viz., the prostate, the rectum, and the vagina. Moreover, the anterior attachment does not pass straight across the pubes, but dips down in the middle line to the apex of the prostate, forming the anterior true ligaments of the bladder, the interval between which, it will be observed, corresponds to the interval between the two levatores ani. The line along which the recto-vesical is continuous with the obturator fascia, extending from the back of the pubes to the ischial spine—i.e., the line of origin of the levator ani muscle

—is usually described as the *white line*. There is, as a rule, no white line where the muscle is attached, but a very distinct line is always seen more internally, where the sheath of the prostate is beginning to be formed. There the recto-vesical fascia is very narrow, and the thickened part is called the lateral true ligament of the bladder. It is this particular part, the injury of which in lateral lithotomy is almost invariably followed by pelvic cellulitis.

The *sheath of the prostate*, η , is capacious, extending forwards to the posterior layer of the triangular ligament, with which it is continuous at the apex of the prostate, and backwards almost to the ischial spine, o . Between it and the capsule of the prostate is the large prostatic plexus of veins, a . Besides the sheath of the prostate, the recto-vesical fascia supplies a thin covering to the lower part of the bladder, both in front and behind.

The *sheath of the rectum*, ι , is said to include the lower four inches of the bowel, but it becomes very thin and almost indistinguishable at the lower part. Between the fascia covering the rectum and that over the back of the bladder, are the two vesiculæ seminales, ω , a sheath for which is sometimes described, but it is scarcely worthy of the name. The vesicula may be reached, in dissecting the pelvis from the side, by cutting through the inner part of the sheath of the prostate, as was done in this case.

To recapitulate, then, the manner in which the fasciæ are continuous with one another: the posterior layer of the triangular ligament is joined by the recto-vesical fascia at the apex of the prostate, and to some extent it is continuous with the obturator fascia at its attachment to the pubic arch; the recto-vesical is attached at its sides to the obturator fasciæ, and is continuous behind with the fascia over the pyriformis, coccygeus, and sacrum; and the pyriformis fascia is not only connected in this manner with the recto-vesical fascia, but ends at the two sides by blending with the deep surface of the obturator fascia.

Covering the outer surface of the levator ani muscle is a thin fascia called *anal*, derived from the obturator fascia below the line from which the levator ani arises.

Any special description of the vessels, muscles, &c., here exposed will be best postponed till after the consideration of the next Figure.

FIG. 2.

The dissection here shown was prepared from the last by removing the whole of the recto-vesical fascia and the sheaths derived from it, and cleaning the structures thus exposed; which process included the removal of the prostatic plexus of veins. The remains of the ilium and part of the sacrum were taken away by sawing through the latter bone; and the ischial spine, with the large and small sacro-sciatic ligaments were removed, as well as the remains of the origin of the gluteus maximus. The incision through the soft parts behind was made to correspond with that in the sacrum, and a considerable piece of the origin of the multifidus spinæ was thus divided.

The *bladder*, θ , in this subject was a small one; it was distended with fluid to as great an extent as was consistent with the employment of a moderate force. As a result of its small size the obliterated hypogastric artery, ϵ , is but slightly in contact with it, while the vas deferens, δ , hardly touches it; whereas, if the bladder be large and distended, both the obliterated artery and the vas deferens are in much closer relation with it. The reader will not fail to notice, by comparing Figs. 1 and 2, that a small part of the bladder is exposed by opening the sheath of the prostate; it is obvious, that this part may be cut in the operation of lithotomy without encroaching upon the cellular tissue of the pelvis, and thus without exposing the patient to the risk of pelvic cellulitis.

In contact with the sides of the moderately distended bladder are the obliterated hypogastric artery, the vas deferens,

and the ureter. In front, if we are to adopt the usual method of description, it touches the back of the pubes and the triangular ligament. Below it rests on the prostate, the vesiculæ seminales and vasa deferentia, with the second part of the rectum. Behind it looks towards the recto-vesical pouch. But as the lowest part of the bladder in the erect posture is that in front of the neck, and the so-called anterior wall is really the inferior, the nomenclature should for accurate description be changed; the fundus should be called the posterior part and the surface covered by peritoneum the superior. This will be made clear by looking at Plate 22, Fig. 2; it may possibly serve to explain the fact that stones are found lodging behind the pubes, and even encysted there. The apex of the bladder is prolonged upwards by the urachus, an obliterated communication between the bladder and the allantois. It does not reach the level of the brim of the pelvis when the viscus is only moderately full, but if over-distension occur it may reach up (in front of the peritoneum) for a considerable distance. Under such circumstances, the sense of fluctuation may be readily obtained by placing one hand on the lower part of the abdomen above the pubes and inserting a finger of the other into the rectum.

The *prostate*, *v*, is usually, and not inaptly, compared to a chestnut, which it closely resembles both in shape and size. The widest part is directed upwards and forwards towards the apex of the bladder, which it surrounds; while the apex touches the back of the triangular ligament about an inch below the apex of the pubic arch. The common ejaculatory ducts enter it at the posterior and upper part, and like the urethra pass through its substance. The direction and position of the prostatic part of the urethra have been shown in Plate 22, Fig. 2. The posterior part of the prostate is in contact with the rectum. Besides its own special capsule it is enclosed in a large sheath, derived from the recto-vesical fascia (p. 222), between which and the gland is the plexus of veins called prostatic. The

under, or posterior, surface of the prostate presents a division into two lobes, the lateral lobes. A third lobe is described in the interior as projecting into the floor of the urethra, but it can scarcely be said to exist unless the gland is enlarged. In the young adult subject the prostate may be felt through the rectum as a distinct roundish mass, and the finger can be readily passed on either side of and beyond it; but as age advances it usually becomes enlarged, and then forms a broad and hard tumour, reaching sometimes from side to side of the bowel, and often extending upwards beyond the reach of the finger. When the middle lobe is enlarged, it forms a projection at the neck of the bladder, which materially interferes with the exit of the urine, as from its position it may act as a valve during micturition. It also seriously impedes the passage of a catheter. In passing an instrument in such a case, it must be remembered that the direction it should assume, as it enters the bladder, is forwards or slightly downwards towards the pubes, and that any attempt to force the beak of a catheter onwards after it has hitched against a large middle lobe, is not likely to prove successful, except after laceration of the gland. When the prostate is enlarged the length of the urethra is increased, and a catheter of ordinary length may thus be too short to enter the bladder. For the foregoing reasons a larger and more curved instrument is usually employed in such cases.

The *membranous portion of the urethra*, κ , is that part which occupies the interval between the two layers of the triangular ligament. It is, in the erect position, almost vertical but slants slightly forwards. It is about three-quarters of an inch in length, but as its posterior or lower wall is slightly overlapped by the bulb, it appears to be somewhat shorter than the anterior. It is situated about one inch below the arch of the pubes and is the thinnest part of the urethra. It is very important that its direction should be borne in mind—*i.e.*, nearly vertical when the patient is standing, nearly horizontal when he is recumbent.

The *vesiculæ seminales*, ζ, are two elongated bodies occupying a position between the fundus of the bladder and the second part of the rectum. Each is about two inches long, and nearly half an inch wide. They are separated behind by an interval corresponding to the base of the trigone of the bladder, but in front they approach one another more closely, the whole of the space between them being occupied by the two *vasa deferentia*. The *vesiculæ seminales*, like the *vasa deferentia*, are often affected by a tubercular deposit. In such cases they may be felt as hard masses in front of the rectum; but it must be remembered, that it is only the anterior part of them which, in any case, can come within reach of the finger.

The *rectum*, ο, is divided, for the sake of description, into three parts. The *first*, beginning at the brim of the pelvis on the left side, extending to the middle line or a little beyond it, is said to end opposite the third piece of the sacrum. It rests on the sacrum and the pyriformis muscle, and sacral plexus of the left side. To the left of it are the ureter and the branches of the internal iliac vessels. It is almost completely surrounded by peritoneum, which forms behind a short meso-rectum. In front it is in contact either with the back of the bladder or some coils of the small intestine. The *second part* follows the curve of the sacrum, and occupies nearly the middle line. It extends as far as the coccyx. It is covered by peritoneum anteriorly at its upper part—i.e., as far as the back of the trigone; beyond this point it is in contact with the base of the bladder and the *vesiculæ seminales*, the *vasa deferentia* and the prostate. It rests on the sacrum and coccyx. The coccygeus muscles, and parts of the levatores ani are in contact with its sides. The *third part*, which is an inch and a half long, extends from the tip of the coccyx to the anus. It is curved slightly away from the urethra. This portion of the rectum is surrounded posteriorly and at the sides by the levatores ani muscles. In front it corresponds to the mem-

ranous and bulbous parts of the urethra, and the triangular ligament. At the anus it is surrounded by the two sphincter muscles.

The importance of the curves of the rectum has been before referred to (p. 209). The finger passed into it can distinguish the sphincter muscles surrounding the anus; and higher up, in front, the arch of the pubes, the prostate, and the commencement of the vesiculæ seminales, with the vasa deferentia, and the bladder, if distended; behind, the coccyx and sacrum; and at each side, at least in children, the ischial spine, the small sacro-sciatic ligament and the coccygeus muscle, and possibly more or less of the greater and smaller sacro-sciatic foramina.

A catheter which has been passed into the bladder may be felt in the membranous part of the urethra, and traced back to the apex of the prostate, and in cases of difficulty it may often be guided in the right course by the finger, and may also be felt beyond the prostate in the bladder. If a false passage exist, the instrument usually passes between the rectum and the prostate, and may readily be felt in this situation. A stone in the bladder may be sometimes felt through the rectum, and may occasionally in adults, and almost always in children, be forced out into the lithotomy wound by the finger in the rectum, as in the old Celsian operation, or "cutting on the gripe." A distended bladder forms a large swelling in the rectum, the nature of which can be at once detected by making pressure with the other hand over the pubes. In addition to the structures mentioned above, the finger of the surgeon must be trained to discover tumours of various kinds, both such as affect the rectum itself and such as are outside it.

A small hand may, if the patient be under the influence of chloroform, be introduced into the rectum, and the sphere of investigation and operation in this manner considerably extended.

ARTERIES.

The *anterior* and *posterior* divisions of the *internal iliac artery* are now seen, and some of the branches from the former to the bladder and rectum.

The *obliterated hypogastric*, ϵ , is the continuation of the internal iliac in the fœtus. It is directed upwards and forwards along the line at which the peritoneum is reflected over the bladder. In this part of its course it is external to the ureter and the vas deferens. After leaving the bladder it passes upwards and inwards, along the back of the abdominal wall, to the umbilicus. In this part of its course it is internal to the internal abdominal ring, and corresponds, more or less exactly, to the line of the deep epigastric artery. It is enclosed in a small fold of peritoneum. As far as the upper part of the bladder it is to some extent pervious, and gives off branches; some to the upper part of the bladder are called *superior vesical*, f , g , others lower down are the *middle vesical*, h . The *lower vesical*, i , comes from the internal iliac itself, usually in common with the middle hæmorrhoidal. The small *artery to the vas deferens*, l , came off in this case from the commencement of the obliterated hypogastric.

The *middle hæmorrhoidal*, k , usually leaves the internal iliac in common with the inferior vesical, but in this case it came from the obturator.* It anastomosed, however, with a branch from the internal iliac. It supplies the lower part of the rectum and anastomoses with the superior and inferior hæmorrhoidal.

The branches of the superior hæmorrhoidal are said to pierce the muscular coat of the rectum at a distance of three inches from the anus, and in this case none were to be found outside it in this situation.

* The obturator in this subject sprung from the epigastric, and the middle hæmorrhoidal left it just as it was perforating the obturator membrane.

VEINS.

Of the veins here shown, the only ones requiring mention are those forming the prostatic plexus, and the dorsal vein of the penis.

The *prostatic plexus*, Fig. 1, *a*, surrounds the prostate, occupying the interval between the gland and its sheath derived from the recto-vesical fascia. It is a large irregular plexus which forms a sort of cavernous structure, and empties itself behind into the internal iliac veins, it receives in front the two branches into which the *dorsal vein of the penis*, *β*, divides, and communicates with the veins of the bladder and rectum. The veins of this plexus may cause very considerable hæmorrhage during the operation of lithotomy in a patient of advanced age. They are also particularly liable, after operations in this region, to become the seat of phlebitis; which, under such circumstances, is not unfrequently followed by pyæmia.

NERVES.

The nerves shown in this Plate are all described elsewhere.

PLATE 25.

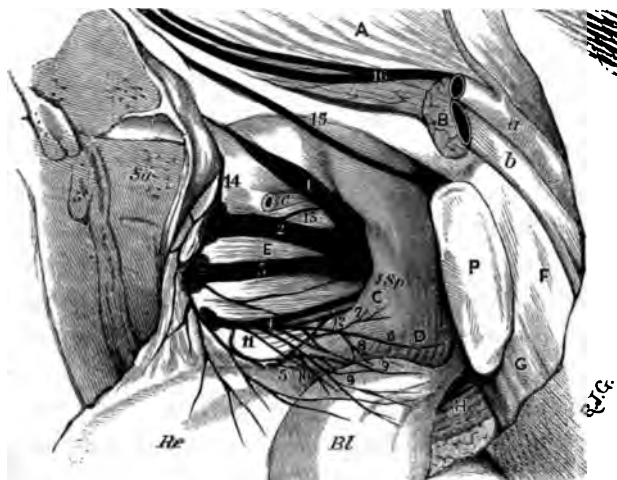
FIG. 1.

THIS dissection, which is intended to show the sacral plexus from behind, was made in the following way:—

An incision along the middle line of the back, extended from the spine of the fourth lumbar vertebra down to the tip of the coccyx. From either end of this a horizontal cut was carried outwards, the lower as far as the ischial tuberosity, and the upper, for a somewhat greater distance, *i.e.*, till it reached the crest of the ilium. The skin having been removed, the cutaneous nerves near the sacrum and coccyx, *viz.*, the posterior primary branches of some of the sacral nerves, were dissected, in order that they might be traced back to their origins. The gluteus maximus was then cleaned (as far as exposed), and after separating its origin from bone and ligament, it was in part removed, the nerves entering its under surface being preserved, but many of the vessels taken away. The origin of the gluteus medius was then cut, and the pyriformis was cleaned, divided, and reflected, the nerves and some of the vessels entering the former being preserved. The great sacro-sciatic ligament was also cleaned, and, after the vessels and nerves which passed through, or over it, had been displayed, it was removed, exposing the small ligament and the vessels and nerves between the two. By removing the small ligament the coccygeus muscle was shown. The vessels and nerves were more fully exposed by taking out the fat from the posterior part of the ischio-rectal fossa, during which process the levator ani was in part uncovered. The remainder of the dissection consisted in clearing away the erector and multifidus spinæ, and in removing a portion of bone by two nearly vertical cuts. One of these was about one and a half inch from the middle line, and passed just outside the lower three sacral

foramina, but opened the first. The other was made through the ilium to about the middle of the upper border of the great sciatic notch—viz., just so far as not to injure the superior gluteal vessels and nerves. These incisions were not completed at one step, and the chisel as well as the saw was used. A certain amount of fat and some fibres of the iliacus muscle had to be removed in order to show the various structures thus exposed.

All of the smaller veins were taken away, as they interfered considerably with a view of the nerves. No further mention will be made of the vessels, except to point out that the *pudic, f*, is sending a branch to the gluteus maximus.



*Visceral Branches of Sacral Plexus.**

1, Lumbo-sacral cord. 2, First sacral. 3, Second sacral. 4, Third sacral. 5, Fourth Sacral. 6, Nerve to levator ani. 7, Its branches to coccygeus. 8, Its visceral branches. 9, 9, Visceral branches of third sacral. 10, Visceral branches of fourth sacral. 11, Branch from third to join the preceding. 12, Pudic. 13, Root of superior gluteal. 14, Sympathetic. 15, Obturator. 16, Anterior crural.

A, Iliacus. B, Psoas. C, Coccygeus. D, Levator ani. E, Pyriformis. F, Adductor Longus. G, Gracilis. H, Gluteus Maximus. Sa, Sacrum. Re, Rectum. Bl, Bladder. I, Sp, Ischial spine.

a, Femoral artery. b, Femoral vein. c, Gluteal artery.

* The complicated network of nerves on the side of the bladder could not be accurately represented without impairing the clearness of the drawing. The principal trunks were faithfully copied from an actual dissection.

The view of the sacral plexus thus obtained is in many respects superior to that which is seen from the front, but it has the disadvantage of not showing the visceral branches. The arrangement of them may be gathered from the woodcut on the previous page.

The small branches to the quadratus and gemelli are concealed by the body of the plexus; they belong more properly to a dissection of the buttock. The reader cannot fail to be struck by the complication of the sacral plexus as thus seen, and by several differences in the arrangement from that which is ordinarily described.

MUSCLES.

The only muscle shown at all completely is the *coccygeus*, E. The fibres of the muscle are so intimately mixed with those of the small sacro-sciatic ligament (especially near the ischial spine), that it is not possible accurately to separate the one from the other. Near the sacrum a ligamentous layer covers the muscle on its outer aspect. The *coccygeus* has a narrow attachment externally to the ischial spine, and a wide one internally to the side of the sacrum and coccyx. Its external surface is in contact with the small sacro-sciatic ligament, while by its other surface it touches the side of the rectum. Its lower edge corresponds with the posterior border of the levator ani. The muscle completes, with the levator ani, the muscular part of the floor of the pelvis, and acts probably, for the most part, with the levator, in opposing the downward pressure exerted by the diaphragm and abdominal muscles upon the viscera. Any action it may have upon the coccyx must be quite insignificant.

The *obturator internus*, G, G, appears twice in this dissection. Its posterior border has been shown in the great sciatic notch by removing a small piece of the fascia covering it, and the muscle is afterwards seen turning round the margin of the small sciatic notch.

NERVES.

The small nerves referred to at p. 203 may now be traced back a step further.

The *hæmorrhoidal branch of the fourth sacral*, 18, passed in this subject, between the coccygeus and levator ani. A twig formed from parts of the anterior primary branches of the fourth and fifth, is seen piercing the coccygeus.

Three of the branches of the lumbar plexus, 1, 2, and 3, were uncovered at the upper part of the dissection.

The cutaneous terminations of the posterior primary branches of the upper sacral nerves, are shown as they appear from under the aponeurosis covering the multifidus spinæ.

The *sacral plexus* is formed by the union of the *lumbo-sacral cord*, 4, with the *anterior primary branches of the first four sacral nerves*. The sacral nerves vary much in size; the first and second are large, the third much smaller, and the fourth smaller still. Of the fourth, a part only enters into the formation of the plexus; another part, not visible in a back view, is distributed to the pelvic viscera and to some muscles.

The different trunks which unite to form the plexus, pass outwards with very varying amounts of obliquity. Thus, while the lumbo-sacral cord is almost vertical in direction, and the first and second sacral both have an inclination downwards, the third sacral is almost horizontal, and the fourth is often directed slightly upwards as well as outwards. The whole plexus thus forms a triangle, the base of which corresponds to the sacral foramina, and the apex, to the commencement of the great sciatic nerve. The first sacral nerve is just above the upper border of the pyriformis muscle; the third is about opposite and parallel to, its lower border; and that part of the fourth nerve which enters the plexus, is small, and throws itself entirely into the pudic. The exact method in which the various nerves join one another, has been described by different authors with a great degree of minuteness, but

any account of this, or the varieties which may be found, is beyond the scope of the present work.

The branches derived from the plexus may be classified into a shorter set, distributed inside the pelvis; and a longer set, which supply parts outside it. The former, which are not shown at all in the Plate, consist of—1. Branches to the pelvic viscera, which are derived from the second, third, and fourth, and join with branches of the sympathetic in the pelvic plexus; 2. A branch to the pyriformis muscle, derived usually from the first, or first and second, at their posterior aspect; 3. A nerve (not always a single trunk) to the levator ani muscle, derived from the fourth. It crosses the coccygeus muscle, to which it supplies branches, and enters the inner surface of the levator ani. Some of the visceral branches to the lower part of the bladder and prostate, are said to come from this nerve. 4. A hæmorrhoidal branch, derived from the fourth, usually passes between the levator ani and the coccygeus, and as we have before seen supplies the skin at the posterior part of the perinæum (p. 203), and also the sphincter ani.

The longer nerves, which pass out of the pelvis are—1. The *superior gluteal*, 10, 10, springing from the lumbo-sacral cord, or from this as well as the first one or two sacral nerves; it passes outwards underneath the gluteus medius, and will be seen in the dissection of the buttock to pass to the two smaller glutei and the tensor vaginæ femoris. In this case the nerve consisted of two distinct portions. 2. The *small sciatic*, 12, 12, second in size to the great sciatic, leaves the lower part of the plexus by one or two roots. These, sooner or later, unite into a trunk, which passes down the back of the thigh, superficial to, but on the same line as, the great sciatic nerve. In the first part of its course it gives off an important branch, which may, however, be more or less distinct from it—the *inferior gluteal*, 13, 13—consisting of several large and variable twigs, which enter the under surface of the gluteus maximus. 3. The *nerve to the obturator internus*, 15, leaves the upper part of the

plexus at the anterior surface, and passes over the spine of the ischium, to be distributed upon the inner surface of the obturator internus. 4. The *internal pudic*, 14, derived usually from the third and fourth nerves, takes a similar course to the last, over the ischial spine to the back of the ischio-rectal fossa, from which point it has already been traced forwards (p. 217). Two or more small nerves, which supply the two gemelli and the quadratus femoris, will be shown in the dissection of the buttock.

The inferior hæmorrhoidal, 16, in this subject, left the fourth nerve independently of the internal pudic. A large cutaneous branch, 17, is pretty constantly found to spring from the third, or sometimes the fourth nerve, and to wind round the border of the gluteus maximus at the back of the ischio-rectal fossa, Plate 21, figs. 1, 2.

FIG. 2

Represents a dissection made to expose such of the abdominal viscera as may be seen in a back view between the eleventh and twelfth ribs above, and the crests of the ilia below. After embedding the subject in plaster of Paris, incisions were made above, along the upper borders of the eleventh ribs so as to half-encircle the trunk; others below, were carried from the spine of the fourth lumbar vertebra along the crests of the ilia, for a similar distance. A vertical incision along the middle line allowed the two flaps to be reflected.

The dissection involved the gradual removal of the muscles in the following order: latissimus dorsi, external oblique, internal oblique, serratus posticus inferior, and transversalis abdominis; and then after clearing away the vertebral aponeurosis, the erector spinæ. Next the multifidus spinæ was removed on the left side, the intertransversales on the right, and lastly, the quadratus lumborum, and the intercostal

muscles of the last space were taken away on both sides. During this process, the nerves which are shown in the Plate, were gradually dissected, and when it was completed, the fascia transversalis was exposed in the interval between the ribs and the iliac crests, while the psoas muscles appeared on each side of the vertebral column, and a small part of the origin of the diaphragm shewed beneath the twelfth rib on each side.

The removal of the fascia transversalis displayed the parts as they are shown in the drawing.

The appearances seen in this dissection are modified by several conditions ; amongst others the length of the twelfth rib, and the extent to which the ligamentum arcuatum externum and diaphragm reach downwards. Thus if the twelfth rib be long, it not only diminishes the amount of space which is uncovered by bone, but it may involve an increased length and lower position of the ligamentum arcuatum externum. As a result of this, the origin of the diaphragm near the spine, may occupy a lower position than usual, and I have seen the pleura in such a case, reaching at least an inch below the twelfth rib. In the subject from which the drawing was made, adhesions had taken place in both pleuræ, and it was impossible to trace the cavity of either below the ribs ; but it is well to remember that, in most cases, it extends downwards to a greater or less extent in this situation.

The following may be taken as a description of what is seen. On each side is the outer and lower part of a *kidney*, that of the right side, ζ, reaching nearer to the iliac crest than the left, ε, and the inner part of each being hidden by the *psoas muscle*, B ; outside the kidney on the right side is the peritoneum, δ, taking the shape of the lower part of the back of the right lobe of the liver, if this viscus happens to project below the ribs ; and lower down is the commencement of the *ascending colon*, θ, uncovered by peritoneum, while outside this and reflected from its side, is another knuckle of the peritoneum.

Outside the left kidney is a piece of peritoneum, α^* . Lower down is the *descending colon*, η , much smaller than the gut upon the opposite side; and on each side of this is the peritoneum again, β and γ .

VESSELS.

Several branches of the lumbar vessels, of small size, were cut during the steps of this dissection. The *eleventh intercostal vessels*, a , a , were preserved, as well as one of the *lower lumbar arteries*, b , and a branch of the *superior mesenteric*, d , on the right side, and one, the *inferior mesenteric*, c , on the left. An artery usually accompanies the twelfth dorsal nerve.

NERVES.

In this subject the *twelfth dorsal*, 7, 7, supplied all the branches usually given by the ilio-hypogastric, and it thus happened that only two nerves were seen crossing obliquely the interval between the ribs and the iliac crests. It must be remembered that there are usually three to be found in this situation.

* In this subject the spleen descended below the eleventh rib, and projected beneath the peritoneum at α .

PLATE 26

REPRESENTS a series of four dissections, which illustrate the arrangement of the lumbar fascia, and the anatomy of the region in which the operation of lumbar colotomy is performed.

The dissection shown in Figs. 1, 2, and 3 were made through the same incision on the skin, but, owing to the stretching of the parts, a somewhat larger surface is exposed in Fig. 2 than in Fig. 1, and in Fig. 3 than in Fig. 2. A line was drawn vertically upwards, from about the middle of the iliac crest to the upper border of the tenth rib, and transverse cuts, about four or five inches long, were made above and below. In Fig. 4 the transverse incisions were carried back to the middle line.

The description of this Plate can hardly be given in the methodical manner which is adopted with those that have preceded it.

FIG. 1.

The cutaneous structures alone have been here removed, showing parts of the latissimus dorsi and the external oblique. The fibres of these muscles are passing in opposite directions; and, if the edge of the latissimus were raised, its slips of origin from the lowest ribs would be found to interdigitate with corresponding slips of the external oblique. The latissimus is tendinous at its attachment to the innominate bone.

The interval between the two muscles corresponds to the middle of the iliac crest. The extent of this interval varies considerably; thus, in a muscular subject, such as that from which the drawing was made, it is altogether wanting; whilst in other cases, there may be a considerable triangular space in which the fibres of the internal oblique appear, following a course almost parallel with those of the latissimus. Through

the fibres of the external oblique the lateral branches of the lowest intercostal nerves make their appearance, of which the tenth, 1, and eleventh, 2, divide at once, after their emergence, into an anterior and a posterior set of twigs, whilst that of the twelfth, 3, 4, passes over the crest of the ilium, a short distance in front of its middle point. These nerves are accompanied by corresponding small branches of artery.

It must be here pointed out that a branch of the ilio-hypogastric usually crosses the iliac crest immediately behind the branch of the twelfth dorsal; this, however, does not pierce the external oblique in its fleshy part, but passes beneath a small tendinous arch close to the bone. It is of very frequent occurrence for one of these nerves completely to take the place of the other in this situation.

FIG. 2.

Underneath the part of the latissimus, shown in Fig. 1, are the tenth and eleventh ribs, with their intercostal muscles and a few fibres of the serratus posticus inferior, D, and a small part of the internal oblique. The external oblique covered another portion of the internal oblique. The fibres of the internal oblique, C, are partly attached to the iliac crest, partly to the fascia lumborum, †. They are continuous with the internal intercostal, F, which projects slightly beyond the termination of the external intercostal, E. The vessels and nerves, which were seen in Fig. 1 piercing the external oblique, are here traced a step further back.

FIG. 3.

On removing the internal oblique, the trunks of the three lowest intercostal nerves are seen passing forwards towards their destination, at the anterior part of the abdominal wall. Beneath them is the transversalis muscle, with its fibres

running transversely, attached, below to the iliac crest, above to the ribs, and between the two, to the fascia lumborum, of which a considerably larger portion is now visible than in the last figure.

FIG. 4.

With a wider incision, and a more extensive removal of the latissimus, a larger piece of the posterior layer of the lumbar fascia or vertebral aponeurosis is displayed, as well as more of the serratus posticus inferior, taking origin from it. By raising a square flap of the transversalis muscle and its aponeurosis, the fascia transversalis was shown beneath it, crossed by the twelfth intercostal nerve, (behind which is usually found the trunk of the ilio-hypogastric, and accompanying which is usually an intercostal artery.

A vertical cut in the fascia transversalis showed the descending colon; and a transverse cut in the fascia, internal to the square flap that had been reflected, displayed the two intervals between the middle and anterior, and the middle and posterior, layers of the fascia lumborum, with the muscles contained in each—viz., the quadratus lumborum, J, and the erector spinæ, H, respectively.

The *lumbar fascia* is the aponeurosis by which the transversalis muscle is attached to the vertebræ. As far back as the edge of the quadratus, it is undivided, but here it splits into two parts. The anterior, the quadratus fascia, which has been before described, page 172, passes in front of the quadratus muscle to be attached near the tips of the transverse processes of the lumbar vertebræ. The posterior, †, passes backwards behind the muscle, and at the outer border of the erector spinæ it splits again, one part continuing between the erector spinæ and the quadratus lumborum to the tips of the transverse processes, the other much stronger, which is joined by the vertebral aponeurosis, ‡, passes back over the erector spinæ, to be attached to the spines of the vertebræ.

The fascia transversalis is here always thin, but in some

ases much more so than in others. It is often a transparent membrane, moving readily over the sub-peritoneal fat, and is thus liable, during an operation, to be mistaken for the peritoneum. The intestine occupies a line almost corresponding to one drawn vertically upwards from a point midway between the anterior and posterior iliac spines, but more accurately to one half an inch further back.

A large artery and vein, branches of the inferior mesenteric, lay, in this subject, immediately behind the gut as it was exposed.

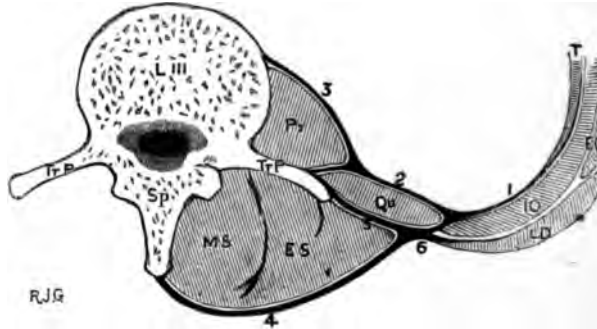
During the operation of *left lumbar colotomy*, as usually performed, the patient is placed on the right side with a pillow under the loins. The position of the descending colon is then marked with accuracy, and a transverse incision is made midway between the crest of the ilium and the ribs, for two inches on each side of the vertical line.

The structures shown in this Plate are successively divided until the fascia lumborum is reached. This is then usually opened and divided on a director, almost as far back as the edge of the quadratus, which muscle should not actually be exposed. The thin fascia transversalis is torn through with the fingers, and the gut is then met with uncovered by peritoneum. The transverse muscular fibres of the gut may usually be seen (the longitudinal bands are generally covered by peritoneum), and will serve to distinguish the intestine from a protruding knuckle of peritoneum which may be forced into the wound by the respiratory movements of the patient, and which, in rare cases, may be distended with gas. By comparing this with the previous Plate, the reader will appreciate the relation of the descending colon to the kidney, and he will understand how, in cases of difficulty, the finger passed back on to the surface of the kidney may help the surgeon to the discovery of the bowel. In cases where the latter is distended, there is seldom any difficulty in detecting it; but, if it be empty, this is often the most troublesome part of the operation.

There are several modifications of the incisions, which it is

not now proposed to discuss. An almost precisely similar operation may be performed upon the right side, in cases when an obstruction is supposed to exist above the splenic flexure. By this means the ascending colon is opened instead of the descending. The advantages of colotomy over any form of gastrotomy, consist in the fact that, if successfully carried out, the cavity of the peritoneum is not interfered with, and it is therefore obviously to be preferred in cases when it is certain that the obstruction is below the hepatic or the splenic flexures. On the other hand, it is often impossible to be at all sure of the locality of the obstruction, and in these circumstances the surgeon may be disappointed by finding a collapsed intestine after making his incision through the muscles. Gastrotomy has the advantage of enabling the operator to explore freely in all directions.

If pus, connected with caries of the spine, have made its way into the sheath of the quadratus muscle, it will pass outwards as far as the edge of the erector spinæ, and then, making its way backwards through the soft parts, may point somewhere near the spine, forming what is known as a *lumbar abscess*.



Section through the Third Lumbar Vertebra showing the Arrangement of the Fascia Lumborum.

1, Undivided aponeurosis of transversalis muscle. 2, Anterior layer, over quadratus. 3, Psoas fascia. 4, Posterior layer, with vertebral aponeurosis. 5, Middle layer. 6, Origin of latissimus dorsi.

E O, External Oblique. I O, Internal Oblique. T, Transversalis. L. D, Latissimus dorsi. Qu, Quadratus lumborum. Pa, Psoas Magnus. E S, Erector spinæ. M S, Multifidus spinæ. L, III, Third lumbar vertebra. Tr P, Transverse process. Sp, Spinous process.

PLATE 27.

FIG. 1

REPRESENTS a side view of the contents of the left side of the thorax, after removal of the lung.

The preparation may be made in a subject in which the abdomen is unopened (or, as in the present instance, in one in which, after the abdominal contents have been removed, the hollow of the diaphragm has been filled with plaster of Paris), by removing the left arm, including the scapula and clavicle, by free incisions, and then cutting through all the soft parts by vertical incisions in front and behind, and clearing them away from the ribs. The first of these incisions is to pass along the middle of the sternum, the second along the angles of the ribs, and they must be joined below by a curved one passing from the xiphoid appendix along the lower margin of the thorax. Afterwards, the cartilages, of the upper six ribs are to be cut through about an inch from the sternum, and those of the seventh, eighth, ninth, and tenth, near the margin of the thorax; and after separating the scalene muscles at their lower attachments, the ribs themselves are to be divided in front of their angles, and, together with the intervening intercostal muscles and the adherent pleura, taken away.

The lung is then to be removed by cutting through its root and the ligamentum latum pulmonis; and the dissection completed by defining the various structures which have been exposed. In the thoracic part of the dissection, this involves the removal of the remaining part of the parietal layer of the pleura, and the clearing away of a variable quantity of loose areolar tissue.

The precaution was taken of passing long needles at various points through the chest walls before opening the thorax, in

order to transfix the heart, and hold it in its natural position after the removal of the lungs.

The preparation shown in Fig. 2, was made after the sternum had been removed, by opening the pericardium, and cleaning the great branches of the aorta.

In looking at this, and the following Plate, we are struck by the extent to which the diaphragm encroaches upon the thoracic cavity, a point which escapes notice in the dissecting-room, as the muscle, in the course of an ordinary dissection, has been allowed to collapse by the opening of the abdominal cavity. This projection upwards of the diaphragm is less marked on the left than on the right side; the difference between the two appears greater than natural in the two Plates, because more of the rib cartilages were removed in the dissection for the right than in that for the left side.

MUSCLES.

For a description of the diaphragm, *see* p. 174. The other muscles shown have not sufficient bearing upon the subject of the Plate to need further description.

ARTERIES.

The *arch of the aorta*, *a*, is, on the whole, better seen from the left side than from in front, and the account of it will accordingly be given here. It is divided, for the sake of description, into three parts—an ascending, a transverse, and a descending. The ascending part is almost entirely enclosed in the serous layer of the pericardium, Fig 2, β ; and, beyond the line at which this is reflected, the fibrous portion is prolonged over it.

Its direction is upwards and slightly forwards, and to the right, and its course somewhat curved, the convexity of the curve looking towards the right. It begins behind the left side of the sternum, at the level of the lower border of the third costal cartilage, and it ends behind the right side of the

sternum at the level of the upper border of the second cartilage. At its commencement it is crossed by the conus arteriosus and by the first part of the pulmonary artery, and it rests upon the auricles, the auricular appendages embracing it upon either side. Beyond the point at which it is crossed by the pulmonary artery, it is only covered by the thin anterior borders of the lungs; in this part of its course it rests upon the right branch of the pulmonary artery, and has the descending cava to the right side, and the pulmonary artery to the left. This is the most superficial portion of the aorta. It presents at its commencement three dilatations, corresponding to the three semilunar valves, called the *sinuses of Valsalva*, from two of which, the anterior and that to the left, spring the coronary arteries. There is another dilatation at the right side, more or less distinctly visible, near the upper part of this ascending portion, called the *great sinus of the aorta*.

The *second or transverse portion* passes backwards and to the left, extending as far as the left side of the body of the fourth dorsal vertebra. Its course is curved in two directions; there is a well-marked convexity to the left, as well as the obvious convexity upwards, which forms the recognised arch of the aorta. It arches over the root of the left lung and crosses some of the structures which occupy the posterior mediastinum. It is covered in front and to the left by the pleura, which separates it from the left lung. The right pleura also touches it at its commencement. It is crossed by the pneumogastric, 1, and the phrenic, 6, between which are several small vessels and two small nerves, a cardiac branch of the sympathetic, 12, and a cardiac branch of the vagus, 5. Two or three minute branches from the pneumogastric to the anterior pulmonary plexus, are leaving the nerve as it crosses the aorta. Passing over the arch from behind forwards, is the superior intercostal vein, γ . Behind and to the right, the artery is in contact with the trachea and the left bronchus, the œsophagus, the thoracic duct, a large number of lymphatic glands, and the body of the

fourth dorsal vertebra, as well as the recurrent laryngeal nerve, and several cardiac branches of nerve, passing to the deep cardiac plexus. The concavity of the arch crosses the left bronchus; attached to it is the fibrous layer of the pericardium, almost throughout the whole of its extent; and, just beyond the point at which it gives off the left subclavian artery, is the upper attachment of the ligamentum ductûs arteriosi. The recurrent laryngeal nerve winds underneath this part of the aorta. From the convexity of the curve are given off the three large trunks which pass upwards to the head and the upper extremities, the innominate, Fig. 2, *b*, the left common carotid, *c*, and the left subclavian, *d*. The left innominate vein is in relation with the upper part of the arch.

The *third part of the arch* is described as extending as far as the lower border of the fifth dorsal vertebra, with the left side of which it is in contact. It is covered on its outer side by the pleura and lung.

The *descending aorta* begins at the lower border of the fifth dorsal vertebra, and extends as far as the aortic opening in the diaphragm, or, in other words, as far as the front of the body of the twelfth dorsal vertebra. It is situated at first to the left of the vertebral column, but at its termination it is almost in the middle line. By its left side it is in contact, throughout its extent, with the left pleura; to the right are the œsophagus and thoracic duct, with the vena azygos major; but at its termination the œsophagus is situated in front of the vessel. In front of it are, the left bronchus, the left pulmonary artery and vein, the pericardium separating it from the back of the left auricle, and a small portion of the œsophagus. Behind it are the vertebral column, and the junction between the azygos veins of the right and left sides. The descending thoracic aorta has thus an inclination forwards, with a curve corresponding to, but more abrupt than, the curve of the dorsal spine; its direction moreover is not vertical, for it slants considerably from left to right.

The branches of the arch of the aorta are five :—the two coronary arteries which arise opposite the semilunar valves, and the three large branches which supply the head and upper extremities. The first two are not shown either in this or the following Plate ; the other three will be described here. The innominate does not appear in this drawing, but it is partly shown in the following Plate.

The *innominate*, Plate 28, Fig. 1, *a*, Fig. 2, *b*, usually leaves the arch a little to the right of the middle line of the body. It is about $1\frac{1}{2}$ to 2 inches long, and is directed upwards and to the right and slightly backwards, ending behind the sterno-clavicular articulation of the right side, by dividing into the right common carotid and subclavian arteries (*see* Plate 4, Fig. 1, *a*). In front of it is the left innominate vein, which crosses it at right angles, the origin of the sterno-thyroid muscle, and the remains of the thymus gland. Behind it is the trachea at the lower part, but as the artery winds backwards the trachea at last lies to its left side, and thus the pleura covers its posterior aspect above. It is also in close contact, at first, on its left side, with the origin of the left common carotid artery. The right innominate vein touches its right side.

The *left common carotid*, Fig. 1, *c*, leaves the arch of the aorta a little to the left of the middle line of the body, and is directed, like the innominate, upwards, backwards and outwards, to reach the back of the left sterno-clavicular articulation. In front of it are, the left innominate vein, which crosses it at an acute angle, and the origin of the sterno-thyroid muscle. Behind it, is at first the trachea, then the œsophagus and thoracic duct, and in this relation also must be given the left subclavian artery and the origin of the left vertebral. To its inner side is at first the beginning of the innominate artery, and afterwards the trachea. Externally it is covered by the pleura, and the left vagus runs along it. The cervical part of the artery has been previously described, p. 42.

The *left subclavian*, *d*, springs from the arch to the left of,

and somewhat behind, the carotid ; and its thoracic part, has a course almost parallel with, but behind that of the latter vessel, to the upper border of the first rib. In front of it is the left common carotid artery, the vagus, the phrenic, and some small cardiac nerves, and near the clavicle, the commencement of the left innominate vein. To its inner side and behind, are the trachea, the œsophagus, and thoracic duct, and the longus colli muscle. Externally it is covered by the pleura.

The branches of the descending thoracic aorta are the intercostals, bronchial arteries to each lung, and small œsophageal and mediastinal vessels.

The *intercostals*, *n*, alone, are seen in the drawing. They are usually ten in number, and pass out in all the intercostal spaces, except the first two, the latter being supplied by the superior intercostal artery, a branch of the subclavian. The last accompanies the twelfth dorsal nerve, and lies beneath the twelfth rib. They leave the back of the aorta (*see* Plate 29), and pass, with varying degrees of obliquity, to the lower border of the rib which limits above the intercostal space which they are destined to supply ; thus the upper ones have, at first, a direction nearly vertical, while the lower are almost, or quite, horizontal from the beginning. Near the spine they send dorsal branches, which accompany the posterior divisions of the intercostal nerves passing backwards like these between the transverse processes, and supplying cutaneous and muscular branches. For about a third of the length of the space, the artery lies at a variable distance between the ribs, for the middle third, it occupies the groove at the lower border of the rib and lies between its accompanying nerve and vein, the latter being uppermost. In the anterior third, the vessel divides into two branches, which run forwards close to the ribs bounding the space, and anastomose with the intercostal branches of the internal mammary. At first, the arteries rest upon the external intercostal muscle, and are covered by pleura ; after-

wards, they lie between the intercostal muscles, and, at last, in the substance of the internal intercostal. The lower six pass beneath the rib cartilages, to enter the interval between the transversalis abdominis and the internal oblique; and they are distributed to the muscles and skin of the abdominal walls, anastomosing with the epigastric as well as with the internal mammary. The intercostal arteries give small branches to the intercostal muscles, the ribs, the subpleural tissue, and also a large lateral branch, which passes outwards with its accompanying nerve, about midway between sternum, or linea alba, and spine, and supplies muscular and cutaneous twigs. The highest vessel sends a branch over the third rib, to anastomose with the superior intercostal; the lowest anastomoses with the lumbar arteries.

The interest of these vessels to the surgeon, is principally connected with operations for opening the pleural cavity. If one of them be divided, the bleeding is very troublesome, from the difficulty which is experienced in attempting to pass a ligature round it. The rule in passing a trochar into the chest is to keep it close to the upper edge of a rib. For the same reason, if it be necessary to remove a portion of a rib with the trephine or otherwise, it is advisable to avoid as much as possible its lower border.

The *internal mammary*, *i*, is a branch of the subclavian, *vide* p. 18; it runs down behind the rib cartilages about half an inch from the sternum as far as the cartilage of the sixth rib, where it divides into two large branches: the superior epigastric, which enters the rectus and anastomoses with the epigastric and the musculo-phrenic. The latter passes outwards beneath the cartilages of the ribs; it supplies branches to the lower intercostal spaces and to the abdominal walls, and, at last, perforates the diaphragm, and is distributed upon its under surface, anastomosing with the phrenic artery, p. 178. In each space, the internal mammary supplies two intercostal branches which run outwards to anastomose with the aortic

intercostals, a perforating branch which passes forwards on to the chest walls, small sternal twigs to the back of the sternum, and thymic and mediastinal branches which pass backwards to the structures in the anterior mediastinum. It gives off besides, the *comes nervi phrenici*, *k*, which accompanies the phrenic nerve to the diaphragm, supplying small branches to the pericardium, and anastomosing with the diaphragmatic arteries.

VEINS.

The intercostal veins will be described with the azygos veins, in connexion with Plate 29. Reference will only be made here, to the *left superior intercostal vein*, *γ*. This passes forward, and then upward over the arch of the aorta, to join the left innominate vein. As it makes its turn upwards, it usually receives a small tributary from the pericardium, which, together with the perpendicular part of the vein, is the remnant of the foetal left descending cardinal vein. Inside the pericardium are found other remains of this vessel:—the vestigial fold which lies in front of the root of the left lung, the oblique vein on the back of the left auricle, and lastly, the coronary sinus into which this small oblique vein opens (Marshall). The left cardinal vein sometimes persists after foetal life, in which case, the left innominate may be small, or wanting. This gives rise to what has been called a double superior cava.

NERVES.

The *left phrenic*, 6, enters the chest by winding over the internal mammary artery. It crosses the arch of the aorta, and passes in front of the root of the lung to the diaphragm, which it perforates to be distributed upon its under surface (p. 184). It is more superficial than the nerve of the opposite side, and it passes much further from the middle line on account of the greater projection of the pericardium to the left.

The *left vagus*, 1, enters the thorax, beneath the left

innominate vein, and to the outer side of the left common carotid artery. It is directed almost vertically downwards in front of the left subclavian artery to the arch of the aorta, which it crosses, and then, passing behind the root of the lung, where it becomes plexiform and supplies a large number of branches to the posterior pulmonary plexus, it is applied to the side of the œsophagus. Here it breaks up into a plexus of nerves, the plexus gulæ, which unite into a single trunk at the lower end of the œsophagus, on the anterior surface of which it passes through the diaphragm, to be distributed upon the anterior surface of the stomach. The *inferior laryngeal*, 4, leaves the vagus as it crosses the aorta, it passes beneath and behind the arch external to the ductus arteriosus and is continued between the trachea and œsophagus to the neck. It supplies cardiac branches which enter the cardiac plexus.

That part of the *sympathetic system* which is found in the thorax, includes the termination of branches, which take their origin in the neck, and the formation of others, which are destined for the supply of viscera in the abdomen. The thoracic part itself, consists essentially of a series of ganglia situated on the costo-vertebral articulations, the upper border of the heads of the ribs, or the intervertebral foramina. They are usually twelve in number, but sometimes the first is amalgamated with the inferior cervical ganglion, and one or other of the lower ones may be blended with that which lies above or below it. They are united together by tolerably thick communicating cords, and similar cords unite the highest with the lowest cervical, and the lowest with the first lumbar ganglion.

They supply internal and external branches. The external are branches of communication with the intercostal nerves which are usually two in number for each ganglion. The internal branches, from the lower seven or more ganglia, unite to form the splanchnic nerves, which pass down through the pillars of the diaphragm to join the various plexuses of the sympathetic in the abdomen. The branches which unite to

form these nerves, pass, in the case of the upper ones, nearly vertically, in the case of the lower ones, more nearly horizontally, and they result at last in two or three trunks. The *great splanchnic*, 14, receives its roots from the sixth to the tenth, but often has another origin from the fifth or even a higher ganglion; it enters the similunar ganglion. The *small splanchnic*, if there be one only, comes from the tenth, eleventh, and twelfth; if there be two, the small splanchnic proper comes from the tenth and eleventh, while the *smallest splanchnic* comes from the twelfth. Both are united by branches with the great splanchnic, and end by passing partly into the solar, partly into the renal plexus. The internal branches of the upper five ganglia are distributed in a variety of ways; some branches pass into the vertebræ, others on to the aorta; and some join in the pulmonary plexus with the branches of the pneumogastric.

The *cardiac plexuses* are described as two in number, but they are united to one another by communicating twigs. The most important, or deep cardiac plexus, is situated between the trachea at its bifurcation and the arch of the aorta, and may be said to be limited above and to the right by the arch of the aorta, below by the pulmonary arteries, and to the left by the ductus arteriosus. The superficial plexus is described as surrounding the ductus arteriosus. The cardiac nerves are principally derived from the pneumogastric and sympathetic in the neck, but a few leave the pneumogastric in the thorax; some come from the inferior laryngeal on both sides, the larger of which are on the left. The cervical cardiac branches of the sympathetic are usually three in number (p. 22), of which all those of the right side, and at least one of the left, pass behind the arch of the aorta to the deep part of the plexus. One or two of the three on the left side cross the transverse part of the arch, and enter the superficial part of the plexus. The cervical cardiac branches of the vagus are usually one or two, from the upper

part, which generally join with the cardiac branches of the sympathetic ; and a large branch below, (depressor nerve of the heart) which passes on the right side in front of the sub-clavian artery, and on the left in front of the arch of the aorta to the cardiac plexus. From the cardiac plexus are derived the two coronary plexuses, anterior and posterior, which accompany the arteries of the same name to the front and back of the heart.

FIG. 2.

This drawing illustrates the structures that were seen on opening the pericardium in the dissection shown in Fig. 1. The *left ventricle*, ζ, forms a marked projection which ends below in the apex of the heart, and which forms in front the rounded left border, *margo obtusus* ; on its surface are some branches of the *left coronary artery*, *f*. In front of the left ventricle is shown a part of the *right ventricle*, ε, the upper part of which, the *conus arteriosus*, γ, is prolonged across the first part of the arch of the aorta into the *pulmonary artery*, *e*. Applied to the side of the pulmonary artery is the *left auricular appendix*, δ ; and in front of it is the commencement of the *aortic arch*, *a*.

PLATE 28.

FIG. 1.

THIS drawing illustrates similar conditions on the right side of the chest to those shown on the left, in the last Plate. The description of the method of preparation there given, (p. 243), will answer for the present dissection, if the word right be throughout substituted for left.

The dissection in the neck was not, however, carried so deeply as upon the opposite side. The root of the lung was divided at a greater distance from the middle line, and the bronchus had, at the point of section, already divided into its two branches.

The diaphragm projects upwards, further on this side than on the other, and, in this way, diminishes the size of the chest in the vertical direction. But, on the other hand, the heart forms a much greater prominence on the left than upon the right side.

The muscles and arteries require no further mention beyond that which will be found in the description of the foregoing Plate. The great veins may, however, be well seen in this dissection, and if this drawing be compared with Plate 4, Fig. 1, their arrangement will be pretty completely illustrated.

VEINS.

The two innominate veins begin behind the inner end of the clavicles, the left being somewhat nearer the sterno-clavicular articulation than the right. The former has been previously described (p. 45).

The *right innominate vein*, γ , passes downwards and slightly inwards, for about one inch and a quarter, till it meets with the left innominate vein, at the right side of the innominate

artery, close to its commencement. It corresponds internally and behind to the right innominate artery. Externally it is covered by the pleura, and is in relation with the phrenic nerve, and it lies behind the inner end of the clavicle, the sternum, and the origins of the sterno-hyoid and sterno-thyroid muscles. It receives the vertebral vein close to its origin, and also the internal mammary and inferior thyroid, and generally the superior intercostal, but the latter often opens into the vena azygos major, as indeed sometimes happens with that of the left side.

The *superior or descending cava*, δ , is about three inches long, and is enclosed at its lower part in the pericardium. This lower part is represented in Fig. 2 by the fold behind the first part of the arch of the aorta. It descends almost vertically, or with a slight curve, the convexity of which is to the right, and ends in the right auricle. It is in relation externally, with the pleura and the pericardium and the phrenic nerve; behind, with the right bronchus and the right pulmonary artery, and internally with the arch of the aorta, while in front it is covered by the pleura.

It receives the vena azygos major, ϵ , which arches forwards, over the root of the right lung, and enters the vena cava about an inch and a half from the termination of the latter—i.e., just before it perforates the pericardium.

NERVES.

The differences between the *phrenic nerves* of the two sides has been referred to at page 250.

The *right pneumogastric*, 2, enters the chest, like the corresponding nerve on the left side, beneath the subclavian vein. It passes backwards and downwards, along the side of the trachea, to reach the root of the lung, where it becomes plexiform and sends many branches to the posterior pulmonary plexus. It then passes behind the root of the lung to the œsophagus, where it breaks up, like the left vagus, into the plexus gulæ,

and ultimately enters the abdomen, by passing through the diaphragm on the posterior surface of the œsophagus. It supplies small branches to the front of the root of the lung, which form the anterior pulmonary plexus. It also sends numerous and irregular branches to the back of the root of the lung, to the posterior pulmonary plexus, and others to the pericardium. Some small branches pass into the cardiac plexus, which are derived from the trunk of the *vagus* in the thorax, beside those which come from the recurrent laryngeal.

A *cardiac branch of the sympathetic*, 3, is seen passing down the side of the trachea, to join the deep cardiac plexus.

This drawing, and the corresponding one on the preceding Plate, were made from a body which had been injected through the femoral artery. The aorta is thus full, while the vena cava and right auricle are collapsed.

FIG. 2.

On opening the pericardium and taking a full side-view of its contents, a comparatively small piece of the heart appears exposed and the part that is seen does not form a marked projection as it does on the left side. In front is the right border and anterior surface of the *right ventricle*, *θ*, passing upwards and to the left into the conus arteriosus, which rests, as has been said, on the commencement of the first part of the arch of the aorta. Behind the ventricle is the right auricle, of which again the right border is visible, and passing into which, at its upper part, is the superior vena cava, shown in the drawing by the fold which lies immediately behind the first part of the arch. The auricle is prolonged forward into the triangular auricular appendix, which applies itself to the side of the first part of the aorta, its tip reaching round as far as the anterior surface of the latter.

In the preparation, owing to the distension of the aorta by

n, and the collapsed condition of the vena cava, the seems to lie behind the former, but if the vein had been l it would appear more to the right side of the

The whole of the ascending portion of the arch of aorta is included in the serous part of the pericardium. The line at which the serous layer is reflected, should be compared with that seen in Fig. 2 of last Plate, of which it is a continuation. Between the vena cava and the aorta, a needle can be passed across to the left side of the pericardium, where the serous membrane forms a distinct sheath, on the one side for the vena cava, and on the other for the aorta and coronary artery. Behind the auricle, the pericardium passes over the pulmonary veins, which are shown in the drawing passing through it. If the diaphragm were pressed down, and the right auricle raised, the ascending cava would be seen passing over the tendinous part of the diaphragm to enter the right part of the right auricle.

PLATE 29.

FIG. 1.

THIS drawing represents the view that may be obtained by removing the back of the thoracic parietes, from the level of the lower border of the second to that of the upper border of the eleventh dorsal vertebra. The subject must first be immovably fixed, as by imbedding it in plaster of Paris.

The dissection through the soft parts involved an incision along the middle line, from the first to the eleventh dorsal spines, and transverse ones at either end of this; of which the upper passed as far as the inner border of the acromion process, and the lower almost half encircled the body. After reflecting the skin and subcutaneous tissue, the trapezius and latissimus dorsi were met with, between the diverging borders of which, the infra-spinatus, the rhomboideus major, and an intercostal space, were in part uncovered. The trapezius and then the latissimus dorsi were removed as far as they were exposed, together with the spinal accessory nerve and some branches of the superficial cervical artery, in this way uncovering more intercostal spaces and the greater part of both rhomboid muscles. On taking away the rhomboideus major and the nerve supplying it, as well as the posterior scapular artery, the serratus posticus superior was seen, and after the partial removal of this small muscle and of the serratus posticus inferior, the ribs were completely uncovered between the borders of the scapulæ. It only remained to divide the ribs and intercostal muscles, as far as possible from their vertebral attachments, and to disarticulate or saw through the lower part of the second and the lower part of the tenth vertebræ, and carefully to separate this portion of the chest-walls from the subjacent pleuræ and the structures inclosed in the posterior mediastinum.

The description of the *mediastina* is associated with a considerable amount of vagueness, and differs widely in the hands of different writers on anatomy, and thus the notion entertained of these parts by the student is often very indefinite and confused. This arises from the fact that there is no well-defined line of demarcation between the several parts of the mediastinum, as usually enumerated in the text-books. The clearest idea will probably be obtained by speaking of the mediastinum at first as of a single space—viz., the interval between the two pleuræ—and by afterwards considering the manner in which, for the purposes of description, it has been subdivided. The shape of the cavity of the thorax may be looked at as a rough approximation to a cone; with a blunt apex, a hollowed base, curved and not straight sides; considerably flattened from before backwards, and much longer behind than in front. But the shape of the cone is still further modified by the projection into it behind of the prominent bodies of the vertebræ, which form the commencement, as it were, of a septum dividing the cavity into two lateral compartments. Placed along the front of the spine, and occupying the interval between it and the sternum, are the aorta and the œsophagus, the trachea and the bronchi, the heart, the large vessels passing to and from the neck, lymphatic glands in abundance, and a considerable amount of cellular tissue holding these various structures together; so that by this means the two halves of the thorax are completely separated one from the other. Starting from this irregular median septum, midway between the upper and the lower parts, but nearer the back than the front of it, are the several structures that enter into the formation of the roots of the lungs.

The pleuræ, like all other serous membranes, consist of two portions—a visceral, which closely invests the lungs and their roots; and a parietal, which is attached to the various parts of the walls of the cavities in which the lungs are contained—i.e.,

the ribs and intercostal muscles, the upper surface of the diaphragm and the objects which have been enumerated as forming the median septum. The visceral and parietal portions of the pleura are continuous with each other at the commencement of the root of the lung, and for a considerable distance below this, where a fold exists, the *ligamentum latum pulmonis*, connecting the inner surface of the lung below its root, with the outer side of the pericardium.

The lung fills almost completely the cavity of the chest; and thus the visceral layer is throughout in perfect apposition with the parietal layer, except in those regions into which the lung does not extend. But the parietal layers of the two sides, owing to the existence of the structures forming the median septum, are everywhere more or less widely separated, or at most, come into contact at one part, close to the sternum, opposite the second, and perhaps the third, parts of this bone. It is to this irregular interval between the two pleuræ, that the term *mediastinum* is applied.

The methods of subdivision of this space have been numerous; the object of such a subdivision, being that of enforcing a clear and orderly appreciation of the relative position of the thoracic viscera. The following description is taken from the excellent "Note on the Mediastinum Thoracis, by John Struthers, M.D.," which appeared in the *Journal of Anatomy and Physiology*, May, 1869. The anterior and posterior mediastina, in this article, are described as the spaces between the diverging pleuræ, in front of and behind the pericardium, but limited above by the level of the fourth dorsal vertebra. The *posterior mediastinum* contains the descending thoracic aorta, the œsophagus with the vagi nerves, the thoracic duct, and the vena azygos major; while the *anterior mediastinum*, which is in the fœtus wide and occupied by the thymus, is in the adult vacant. The description of the *superior mediastinum* I will give in Dr. Struthers' own words:—

"The discrepancy or vagueness in the books in regard to

the mediastinum in which the parts contained between the three upper dorsal vertebræ and the manubrium sterni are placed, is unavoidable from the arrangement of the parts; some are anterior, some middle, some posterior, without regional division or distinct stratification, and the lateral pleural boundaries of the space pass from sternum to spine without interruption. I have, therefore, been in the habit of giving a distinct name to this region—the “superior mediastinum,” a term with which my pupils have long been familiar. I define it as bounded behind by the three upper dorsal vertebræ, in front by the manubrium sterni, on each side by the uninterrupted pleura; as reaching above to the superior aperture of the thorax, below to the top of the aortic arch. Its contents are—first, the venous layer of the left and right innominate veins; next, the arteries, the innominate, left carotid, and left subclavian; the phrenic, vagi, cardiac, and left recurrent nerves; the trachea, the œsophagus, and the thoracic duct.” The definition of the middle mediastinum becomes now, as Dr. Struthers says,—“clear by exclusion. It is the part of the general mediastinal space not included in the above definitions of the superior, anterior, and posterior mediastina. I subdivide it into two parts—the lower, or *cardiac* part, containing the heart (with the thoracic stage of lower cava), surrounding pericardium and phrenic nerves, bounded on each side by the pericardial pleura; and the upper, or *aortic* part, containing the upper part of the pericardium, the aortic arch, superior cava, and arch of the vena azygos, pulmonary artery and its divisions, pulmonary veins, the bifurcation of the trachea and the bronchi, including all the parts which form the root of the lung. It includes, also, its stage of the phrenic and vagi and left recurrent nerves.”

This description has an advantage over most in the fact that it is definite and unmistakable; but it must not be forgotten that many others have been put forward. As an example of one, which reduces the subdivision to a mini-

mum, may be taken that which separates the mediastinum only into two parts, anterior and posterior, at the line of the posterior aspect of the trachea and bronchi, and of the pericardium.

Mediastinal tumours, of whatever nature they may be, are liable to cause very marked symptoms, as the result of pressure upon the important structures amongst which they are developed. The locality of such a tumour may occasionally be diagnosed by an area of superficial dulness, if the growth approach the surface; such a condition being more common in the anterior than the posterior mediastinum. More frequently the nature of the pressure effects produced, will indicate the seat of the affection, by showing which organ has had its function interfered with. Mediastinal tumours are of very various nature; they may be independent growths, sarcomatous, syphilitic, &c.; or they may be connected with one or the other of the structures occupying the mediastinum—such, for example, as an aneurism of some part of the aorta, or a glandular affection. The last is one of the most common conditions; and it must be remembered, in connexion with this subject, that the mediastinal lymphatic glands may not only be involved in a general constitutional disease, such as lymphadenoma, syphilis, &c., but that they may become secondarily involved as a result of local mischief elsewhere. The lymphatic glands in this region are very numerous, and may be classified for convenience in the following groups (see Henle): 1. Sternal, arranged beneath the sternum along the internal mammary vessels, and receiving their supply of lymph from the rectus abdominis, the diaphragm, the intercostal spaces, and the inner part of the breast. 2. Intercostal, near the heads of the ribs, which receive their afferent vessels from the spinal canal, the back muscles, the inner part of the chest wall, and in part from the diaphragm. 3. Anterior mediastinal, situated in a plane anterior to the pericardium, the lower ones being close to the diaphragm, and the upper in front of the

arch of the aorta and the left innominate vein. Their afferent vessels come from the sternal glands, and also from a large part of the liver, the diaphragm, the thymus gland, the pericardium, and the heart. 4. The posterior mediastinal lie along the descending thoracic aorta and draw their supply of lymph from the œsophagus, the back of the diaphragm, the back of the pericardium, and part of the liver. 5. The bronchial, which are very numerous, are placed about the bifurcation of the trachea, and at the hilus of the lung. They are, in adult life, almost invariably of a deep black colour, from the accumulation in them of pigment. Their afferent vessels are derived from the lungs, the trachea and bronchi, the back of the heart, and from the posterior mediastinal glands. The foregoing enumeration will indicate the variety of parts which may serve as starting-points for secondary mediastinal glandular affections. The bronchial glands are often enlarged in the course of chronic diseases of the lungs; they may undergo cheesy degeneration, or suppurate, giving rise to mediastinal abscess. A mediastinal abscess does not, however, necessarily arise in this manner, but may be connected with softening tubercle in the lung, with disease of bone, either in the sternum, ribs, or vertebral column; or it may result from the gravitation of pus from the neck, behind the deep layer of the cervical fascia which is attached to the back of the sternum (see page 2). The operation of trephining the sternum in order to give a free exit to such an abscess has been suggested, and indeed practised in former years by Petit, Lamartinière, and others, but the small and uncertain size of the anterior mediastinum in front of the heart, causes the danger of opening the pericardium or the pleura by such an operation to be considerable, and it is now scarcely included amongst the legitimate operations of surgery.

The *thoracic duct*, x, is now seen from a little above its commencement to the point at which it passes forwards on the left side of the œsophagus. This drawing should be compared

with Plate 13, Fig. 1. Beginning at the receptaculum chyli, in front of the first, second, or third lumbar vertebra, or sometimes even higher still, it passes upwards in front of the vertebral column, between the aorta and vena azygos major, superficial to the right aortic intercostal arteries. Opposite about the fourth dorsal vertebra, it begins to pass slightly forwards, along the left side of the œsophagus, and runs upwards along this tube between the subclavian and carotid arteries, ending as has been before seen (Plate 1, Fig. 2, page 7) by winding over the anterior scalene muscle, and entering the point of junction of the internal jugular and subclavian veins.

ARTERIES.

The *descending thoracic aorta*, *a*, has been described at page 246, the *intercostal branches*, *b, b*, are now seen to arise from its posterior aspect. The back of the first part of the *left subclavian artery*, *c*, is shown passing upwards to the neck.

VEINS.

The azygos veins are liable to considerable variation. The following condition is that which is usually described as normal. The *vena azygos major*, *a*, beginning by radicles derived from some of the lumbar veins, and also the renal vein, passes upwards behind the diaphragm through the aortic opening, and is continued along the right side of the anterior aspect of the vertebral column as far as the upper part of the root of the lung, over which it bends to enter the vena cava superior just as the latter is about to pierce the pericardium (Plate 28, Fig. 1, *ε*). In its course it receives the intercostal veins of the right side, corresponding to all the spaces except the upper two. It also receives branches from the œsophagus, and the posterior mediastinum, and the right bronchial vein. The vena azygos major is joined opposite the seventh dorsal vertebra by a large trunk, the *vena azygos minor*, *β*. This commences in the same way as

the vena azygos major on the left side of the body. It passes into the thorax by the aortic opening of the diaphragm, and receives commonly the *smallest azygos vein*, γ , as it is about to turn across the vertebral column. The smallest azygos vein receives the intercostal branches, corresponding to the spaces between the second and the seventh, and, like the vena azygos major, œsophageal and mediastinal veins, and the left bronchial vein, if this have not entered one of the intercostal, or the superior intercostal vein. Often, however, the smallest azygos vein passes across the spine separately from the vena azygos minor; and frequently it does not receive all of the intercostal veins between the second and seventh, but another intermediate trunk collects the branches corresponding to two or three intercostal spaces. The superior intercostal veins often open into one or other of the azygos veins.

Besides the communication below with the renal and lumbar veins, the azygos veins communicate by means of their intercostal branches with several other veins. Thus the upper of them is joined by a connecting trunk with the superior intercostal vein, and so, indirectly, with the innominate. The intercostal veins communicate in front with the internal mammary veins, which also enter the innominate; and, by means of their posterior branches, with the intra-spinal plexus. It is thus evident that in cases of obstruction to the lower cava from plugging, the presence of tumours, or otherwise, the blood from the lower extremities can be carried by the azygos system of veins, to the superior cava, and so returned to the heart. If the superior cava be obstructed, or obliterated, as has in very rare cases been described, the current in the azygos veins may be reversed and the blood returned through them by means of their lower set of anastomoses, to the inferior cava and thus ascend to the heart. The latter process would be facilitated, by the almost complete absence of well-developed valves in these vessels; but, it should be remembered that valves exist

in the vena azygos major at, or just beyond the point, at which it arches over the root of the right lung.

NERVES.

The *right vagus*, 1, is shown on the posterior aspect of the œsophagus. The representation of the end of the sympathetic was necessarily somewhat diagrammatic.

FIG. 2.

THIS dissection, which shows a deeper view of the contents of the thoracic cavity, as seen from behind, was made from that which is shown in Fig. 1, by the following means:—After clearing away the sympathetic nerves, the parietal pleura, which had been exposed, was removed, so as to uncover the back of the lungs, and as these had been allowed to collapse, the posterior aspect of their roots became also apparent. The greater part of the lower lobes was also removed, in order that the pericardium and the roots of the lungs might be more conveniently exhibited. The aorta was divided at the commencement of the descending portion, and again at the lower part of the dissection, and the intervening part was removed with the intercostal branches attached. The azygos veins, thoracic duct, and the œsophagus were also taken away, leaving the pneumogastric nerves; and the pleura was removed from the back of the right innominate vein and the beginning of the descending cava. Lastly, a large quantity of bronchial glands were cleared from about the trachea and bronchi, together with a considerable amount of cellular tissue by which the parts were held together.

Attention has been drawn, in the description of the last Plate, to the amount of black pigment which these glands usually contain; the cellular tissue which surrounds them is often tough and dense; and these facts combine to make the dissection here shown a tedious, and often a difficult one.

The pericardium, †, is partly overlapped by that portion of the left lung, which is here unremoved. Had it been completely exposed, it would present the shape of a very much truncated cone, more or less similar to that which is seen from the front. The posterior surface of the pericardium corresponds below to a portion of the back of the left ventricle, and above to the back of the left auricle. Emerging from the pericardium, on each side, are the pulmonary veins, γ , δ , two of which pass outwards to each lung. The pericardium extends upwards as far as the fourth, and downwards as far as the eighth or ninth dorsal vertebra.

The question of the extent, upwards and downwards, of the pleural cavity, and that of the degree to which it is filled by the lung, are of great interest both to the physician and the surgeon, in connexion with the important subject of the most advisable place to puncture the chest, for the purpose of evacuating fluids which have been effused into it. In the healthy state, the pleura extends downwards as far as the margin of the thoracic wall,—*i.e.*, in front, as far as the junction of the sixth costal cartilage with the sternum, and behind as far as the twelfth dorsal vertebra. It does, indeed, as has been before observed, extend behind in many cases a little below the level of the last dorsal vertebra—*viz.*, as far as the ligamentum arcuatum externum. The lung, however, never reaches the bottom of the pleural cavity; the line of its lower border runs from the point of junction of the sixth cartilage with the sternum, to the upper border of the sixth rib in the mammary line, the seventh and eighth ribs in the axilla, and the tenth or eleventh vertebra behind; the left lung usually reaches further downwards than the right. In the lower part of its extent, therefore, the parietal layer of the pleura covering the diaphragm is in contact with that lining the lower part of the thoracic wall.

In cases of pleuritic effusion, the lung recedes from the chest wall, unless adhesions have previously formed between

the adjacent surfaces. There is thus, as a rule, no danger of wounding the lung during the operation of *paracentesis thoracis*. It must be remembered that in many cases, the contiguous surfaces of the pleura, below the level of the lower border of the lung, become adherent to one another, and that thus the cavity of the pleura does not extend downwards as far as the limit that has been described above. The seat of election for puncturing the chest, is said to be the sixth interspace, at the back of the axilla; but, in most instances, there is no reason why a lower position should not be chosen, with a view of allowing the cavity to drain more freely; and if the surgeon contemplate making a second opening, he can usually succeed in ascertaining, by means of a probe inserted through his first incision, the actual extent downwards of the pleura in any particular case; and so may give exit to the fluid at the most dependent possible part.

The *bifurcation of the trachea* is well seen, and also the difference in the direction between the *right bronchus*, $\times$, and the *left*, $+$. A description of these will follow in connexion with the next Plate. It is only necessary here to point out, that the bifurcation of the trachea, being situated opposite the lower part of the fourth or the fifth dorsal vertebra, corresponds in the back to the third dorsal spine; and that, accordingly, the physician may expect to hear bronchial breathing between the scapulæ, opposite the fourth and fifth spines, in patients whose lungs are healthy.

The vessels here exhibited will all be described elsewhere.

The *vagi*, 1, 2, it is needless to say, is represented in a somewhat diagrammatic manner as it has been separated from the œsophagus. Their branches to the back of the root of the lung, to the trachea, and the upper part of the œsophagus, appear in their natural positions. The description of them will be found at page 251.

PLATE 30.

FIGS. 1 AND 2.

THE drawing, for Fig. 1, was made from the same subject as that which was used for the woodcut at p. 270, a young male, aged about eighteen, who had died of diabetes, and whose thoracic viscera were apparently healthy. After cutting down upon the trachea and opening it, a large cork was inserted through the incision, and a ligature was applied tightly at the situation where the cork lay, so as to prevent the occurrence of collapse of the lung when the chest was opened. The sternum and rib cartilages were removed in the manner which is generally employed in conducting a post-mortem examination—viz., by reflecting the skin and soft parts *en masse* by a single mesial incision, and cutting through the sterno-clavicular articulations, and the rib cartilages close to the ends of the ribs. The abdominal cavity was slightly opened. The costal and sternal pleuræ were, in part, taken away with the structures removed. This stage of the dissection is illustrated in the woodcut, which shows—the position and direction of the anterior mediastinum (*see* p. 261), the extent to which the two pleural sacs are in contact with one another, the differences which are to be observed between the anterior borders of the two lungs, and the amount of pericardium which is uncovered by lung. The last steps of the dissection consisted in pulling aside the lungs, and in opening the pericardium by a crucial incision, and drawing the flaps thus formed as far apart as possible.

As the vessels had not been injected, it was necessary to draw the smaller branches of the coronary arteries from a specimen previously prepared. The anterior border of the right lung slants downwards and inwards from the apex as far



Thoracic Viscera seen from in front, undisturbed.

A, Diaphragm. B B, Transversalis Abdominis. C C, Internal Intercostals. D D, Sterno-thyroid.

1 1, First Rib. 2 2, Second Rib. 3 3, Third Rib. 4 4, Fourth Rib. 5 5, Fifth Rib. 6 6, Sixth Rib.

a, Right Lung. b, Left Lung. c, Pericardium. d, Upper part of Anterior Mediastinum (or anterior part of superior mediastinum). e, Lower part of Anterior Mediastinum. f, Liver. g, Stomach. h, Undivided Peritoneum. k k, Clavicle.

as the level of the junction of the manubrium with the body of the sternum, at which point it reaches almost to the middle line; it is then continued almost vertically downwards, but inclining slightly to the right as far as the level of the junction of the sixth cartilage with the sternum, where it passes into the lower border. Traced outwards, this latter is found to cross the upper border of the sixth rib in the nipple line, the seventh rib at the anterior part of the axilla, the eighth rib at the posterior part of the axilla, and to reach the tenth rib at the spine. The anterior border of the left lung, is in its upper part, symmetrical with that of the right lung, but at the level of the upper border of the fourth rib cartilage, it passes downwards and outwards as far as the apex of the heart, after which it is directed almost horizontally inwards towards the junction of the sixth cartilage with the sternum, which point however it does not actually reach. The inferior border of the left lung is slightly lower than that of the right side, and corresponds with the eleventh rib at the spine.

The anterior surface of the pericardium, Fig. 2 *, presents a bluntly conical shape, the base of the cone being downwards at the diaphragm, and its apex occupying the convexity of the arch of the aorta. Small arteries and veins are distributed upon it.

On opening the pericardium, the heart is seen to be surrounded by a small quantity of clear fluid. The surface of the heart is of a brown colour mottled with yellow, the amount of mottling depending upon the quantity of fat beneath the visceral pericardium. The greater part of the front of the heart consists of the anterior wall of the *right ventricle*, Fig. 1, ¶, which passes upwards into the *conus arteriosus*, and this, in turn, gives place to the commencement of the *pulmonary artery*, Fig. 1, d. To the right, is seen the *right auricular appendix*, Fig. 1, †, with a small portion of the right auricle itself, lower down. At the apex, and for a variable distance at the left border, the *left ventricle*, Fig. 1, *, makes its appearance. To the right

side of, and above the pulmonary artery, the *ascending portion of the arch of the aorta*, Fig. 1, *a*, is seen, and to the right of this, again, a small part of the *descending cava*, Fig. 1, *β*.

The two *coronary arteries* leave the first part of the arch of the aorta opposite the anterior, and the left posterior, sinuses of Valsalva, and are seen in front on each side of the commencement of the pulmonary artery. The *right coronary* turns round the auriculo-ventricular septum to the back of the heart, and sends a large branch down the interventricular septum behind; some branches, however, Fig. 1, *b*, turn round the right border of the heart, and are distributed on the anterior surface. The *left artery* winds to the back of the heart, along the left half of the auriculo-ventricular groove, and sends an important branch down the front of the interventricular septum, Fig. 1, *c*. The larger branches of the coronary arteries do not anastomose with one another.

The *great coronary vein*, Fig. 1, *δ*, accompanies the descending branch of the left coronary artery as far as the auriculo-ventricular groove. It then turns backwards in this groove, to reach the *coronary sinus*, which lies at the back of the heart between the left auricle and ventricle. The coronary sinus receives, in addition, the numerous and irregular *posterior cardiac veins*, and the little *oblique vein* to which reference has previously been made, and it opens into the right auricle at the lower part. Some of the *anterior cardiac veins*, Fig. 1, *γ, γ*, are shown accompanying the branches of the right coronary artery. The coronary sinus thus collects the whole of the blood from the heart-substance except such as finds its way into the anterior cardiac veins, and other minute veins, the *venæ cordis minimæ*, which open into the right auricle at various points by small apertures, called the foramina of Thebesius.

Fig. 2 represents the appearance shown in an injected body, in which, after opening the chest in the same way as was done in the preparation of the dissection for Fig. 1, but removing more of the ribs and leaving the upper part of the

sternum, and taking no precautions to prevent the collapse of the lungs. The lungs were drawn aside, and the structures in connexion with the arch of the aorta and the front of the pericardium were carefully dissected. The parts exposed have all been shown in other Plates, and will therefore not require further description in this place.

For the physician it is important to remember the normal position of the heart, and its relation to the lungs. Its extent upwards, is as high as the level of the second, and downwards, as far as that of the sixth costal cartilages; to the right, for an inch and a half from the middle line of the sternum, and to the left (at the apex), as far as three inches from the middle line. The upper and lower limits are represented by nearly horizontal lines; that to the right by a nearly vertical line slightly convex outwards, and that to the left by a line considerably convex upwards and outwards. The left border moreover slants obliquely downwards and outwards, from the junction of the second left costal cartilage with the sternum to the apex of the heart, which is situated at the upper border of the sixth rib, about two inches below the left nipple and one inch to the sternal side of it. This area marks out what is known as the region of *deep cardiac dulness*, though this dulness on percussion can scarcely be detected above the third cartilage. The *superficial dulness* corresponds to that part of the heart which is not overlapped by the margins of the lungs—viz., that area which begins above at the level of the upper border of the fourth rib cartilage, and is bounded to the right by the perpendicular anterior border of the right lung, and to the left by the V-shaped notch in the anterior border of the left lung. It would be out of place here to enter upon a description of the modifications which these areas may undergo; but it may be pointed out that while the deep dulness cannot alter without an actual change in the position of the heart, the superficial dulness may be much diminished, or may altogether disappear, as the result of an insignificant alteration in the size of the lungs.

FIG. 3.

Supposing the thorax to have been opened, by the complete removal of the sternum, and the dissection to have been carried to the extent shown in Fig. 2; the appearance shown in Fig. 3 is obtained by cutting across the arch of the aorta at the junction of its first and second portions, taking the heart and pericardium completely and cleanly away, and carefully defining the structures which are in contact with it behind.

The abdominal viscera are supposed to have been previously removed.

In the neck, the incision is carried in the middle line as far as the thyroid cartilage; and the deep fascia, anterior jugular veins, and sterno-hyoid and sterno-thyroid muscles are turned aside. The thyroid body, with its lower veins and the trachea, are to be cleaned, and the innominate veins taken away. Lastly, portions of both lungs must be removed, in order to show the manner in which the bronchi and pulmonary vessels enter their substance.

The body was that of a middle-aged woman. The thyroid was larger than natural, irregular in shape, and had a very wide isthmus.

It will be remarked that the arch of the aorta reaches in this case to a somewhat higher level than usual. The termination of the pulmonary artery is no doubt straightened out to some extent by the weight of the lungs, but its bifurcation did actually occur in this subject, opposite the lower part of the bifurcation of the trachea. The phrenic nerves are, it is needless to say, quite out of position. A considerable portion of the cardiac plexus was removed from the anterior aspect of the bifurcation of the trachea.

The account of the structures now shown will be found in connexion with the preceding Plates, and to this account a few facts only will be added.

The *ductus arteriosus*, *u*, is shown as it passes upwards from

a spot a little to the left of the point of bifurcation of the pulmonary artery, to join the under surface of the arch of the aorta, just beyond the origin of the left subclavian artery. Corresponding to its point of junction with the pulmonary artery there was a distinct depression on the inner surface of this vessel. The duct or ligament is, in the adult, a fibrous band; but in rare cases it remains patent, as a perpetuation of the original foetal condition, allowing of a constant direct communication between the pulmonary and systemic circulations.

Immediately outside the duct lies the recurrent laryngeal nerve, 3, of the left side, and surrounding it are the branches of communication between the superficial and deep parts of the cardiac plexus.

The right and left pulmonary arteries pass almost transversely outwards, in front of the two bronchi, but behind the upper pulmonary veins. After reaching the lungs, they divide into branches for the several lobes. The right branch is larger than the left, and passes behind the first part of the arch of the aorta and the vena cava superior.

The *oesophageal branches*, *f, f*, of the descending thoracic aorta are usually four or five in number, and irregular in:

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PLATE 31.

THIS dissection, which shows the superficial structures at the upper and outer aspect of the thigh, and the relations of the superficial muscles to one another and to the great trochanter, was made by means of the following incisions. First, one was carried along the whole length of the iliac crest; and from its anterior and posterior extremities vertical incisions were made, the anterior one along the outer border of the thigh in its upper third, the other along the side of the sacrum and coccyx and the back of the thigh for an equal distance. The lower ends of the two vertical incisions were joined by another carried transversely round the outer part of the thigh. The cutaneous vessels and nerves were first dissected, and then the fascia lata was removed from the surface of the tensor vaginæ femoris, as well as from a small portion of the gluteus medius and from the gluteus maximus.

The *fascia lata* forms a complete investment to the thigh, and sends inwards strong intermuscular septa, which are fixed to the bone at the lines of attachment of the muscles. Above, it is fixed to the crest of the ilium, the sacrum and coccyx, the great sacro-sciatic ligament, the tuber ischii, the arch of the pubes, the symphysis pubis, and Poupart's ligament. In the region here shown, we find it forming a strong sheath for the tensor vaginæ femoris; and it receives below the fibres of insertion of this muscle. At the outer part of the thigh the fascia is very strong, forming what is known as the *ilio-tibial band*, $\times$, which crosses the vastus externus muscle, reaching from the crest of the ilium to the external tuberosity of the tibia; this strong band receives, not only the insertion of the tensor vaginæ femoris, but also the greater part of the fibres of the gluteus maximus. Behind the vastus externus, the fascia passes inwards across the thigh on

the surface of the hamstrings, ©. At the lower border of the gluteus maximus the fascia divides into two parts, which pass one on each aspect of the muscle, enclosing it in a thin sheath; while at its upper border they unite to form the strong white layer, ¶, which covers and gives origin to the gluteus medius. . Owing to its great strength the fascia lata has a considerable effect in modifying the course of an abscess, or the shape of a tumour developed beneath it. It has, also, like other strong membranes elsewhere, the following important bearing for the surgeon:—An abscess originating beneath the fascia may burst through it by a small opening, and then form a second sac in the subcutaneous tissues. After evacuating the subcutaneous part of the abscess, if the surgeon do not discover and dilate, say with his finger, the opening in the fascia lata, he will leave the deeper part with an insufficient exit, and may be disappointed that the suppuration does not stop, or possibly continues to extend.

The subcutaneous tissue of this region contains a large amount of fat, especially over the gluteus maximus, which, in some races and individuals, becomes increased to an inordinate extent.

MUSCLES.

The *gluteus maximus*, A, consists of very coarse bundles of fibres directed downwards and outwards, from the back of the pelvis towards the upper end of the femur. Its origin is from the posterior third of the outer lip of the crest of the ilium, and from a special narrow rough surface below it; from the lower part of the tendon of the multifidus spinæ, from the side of the long posterior sacro-iliac ligament, from the side of the last piece of the sacrum, from the back of the coccyx and from the surface of the great sacro-sciatic ligament. It is inserted partly into fascia and partly into bone; the upper fibres end in

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a tendon which blends with the fascia lata over the great trochanter; of the lower set of fibres, the deeper and more numerous end in a strong thick tendon, which is attached to a special rough mark on the outermost line derived from the *linea aspera*, whilst the more superficial are, like the upper set, inserted into the back of the ilio-tibial band.

Superficial to the muscle are the integuments, containing the vessels and nerves to be presently described. Beneath it are the various structures which are shown in Fig. 1 of the following Plate.

The action of the *gluteus maximus* is to extend the hip-joint, and to assist the external rotators. According to Duchenne ("Physiologie des Mouvements," 1867, p. 330), it does not possess the power of abduction which has been often ascribed to it. This author also denies that the muscle has any considerable function to perform in the maintenance of the erect posture; one thing, at least, he thinks is clear, that in standing upright the *gluteus maximus* is perfectly lax. If both muscles be galvanised, the lower fibres, whilst approximating the nates, draw forwards the coccyx. They are relaxed during the processes of defecation and parturition.

The *gluteus maximus* gives shape to the buttock, and its lower border marks the gluteal fold. The wasting of the large muscular mass becomes apparent to the eye even in the early stages of certain diseases, such as that of the hip-joint, which cause its functions to be in abeyance. The flattening of the buttock and the disappearance of the gluteal fold are thus important diagnostic points for the surgeon.

The *tensor vaginæ femoris*, C, the "membranosus" of old anatomists, is a flat muscle which occupies the outer aspect of the thigh, in its upper third, and forms a prominence immediately below the anterior superior spine of the ilium. It is attached above to the anterior superior spine, to the outer lip of the crest of the ilium at the anterior part, through the

intervention of the fascia over the gluteus medius, and to a part of the notch between the two anterior iliac spines. It becomes thin at the lower part, and after having been directed downwards, backwards and outwards, is inserted into the upper part of the ilio-tibial band. By means of this band, the muscle may be said to be inserted indirectly into the outer tuberosity of the tibia. It is enclosed in a strong sheath of fascia lata. Its outer surface is subcutaneous. Its deep aspect is in contact with the anterior borders of the two smaller gluteal muscles and part of the outer surface of the gluteus medius, and also with the vastus externus. Branches of the external circumflex vessels lie beneath it, and the branches of the superior gluteal nerve which supply it, enter its under surface. Its anterior edge corresponds to the outer edge of the sartorius and the rectus femoris.

It acts as an internal rotator and weak flexor of the hip; it also assists the action of the upper part of the gluteus maximus, by fixing the fascia into which this muscle is attached, and so enabling it to act upon the whole limb instead of on the fascia only.

The tensor vaginæ femoris serves as a valuable landmark to the surgeon. Abscesses which have originated beneath the two smaller gluteal muscles, and which are common in connexion with disease of the hip-joint, will generally pass forwards to the anterior border of the gluteus minimus, and then point on one side or the other of the tensor vaginæ femoris. In connexion with this drawing, the position of the incision for excision of the hip may be considered, but the subject will be returned to at the end of the description of the following Plate.

ARTERIES.

The subcutaneous arteries in this region are of slight importance; they are derived from the *lateral branches of the last intercostal, a*, and the *posterior branches of some of the lumbar*

arteries, b, from the lateral sacral, d, the gluteal, c, the sciatic, e, the first perforating, f, and the superficial circumflex iliac, g.

NERVES.

The cutaneous nerves of the buttock are numerous.

The lateral branch of the *last dorsal nerve*, 1, pierces the fibres of the external oblique a short distance in front of the middle of the iliac crest, and passing downwards over it, is distributed to the skin below the anterior half of the crest, and around and in front of the trochanter.

The *ilio-hypogastric*, which is derived from the first lumbar, and belongs to the same series as the last, was not present in this subject, and, indeed, is often absent. It appears beneath a tendinous arch close to the iliac crest, just behind the last dorsal nerve, and is distributed behind it. If the last dorsal be small, this nerve may be of a very considerable size.

The *lumbar nerves*, 2, 3, are the external divisions of the posterior primary branches of the upper two or three lumbar nerves. They cross the iliac crest, and are distributed to the back of the buttock, reaching down as far as the great trochanter.

The *sacral nerves*, 4, 5, are twigs derived from the posterior primary branches of the first four, or of all the sacral nerves. They appear by the side of the sacrum, and send small branches inwards and outwards in this situation.

Near the coccyx are several small nerves which have been before described—viz., the branch formed from twigs derived from the anterior primary branches of the fourth and fifth sacral, which is joined by the coccygeal; the hæmorrhoidal branch of the fourth sacral; and a branch derived from the inferior hæmorrhoidal, or the anterior primary branch of one of the sacral nerves, which winds round the edge of the gluteus maximus (*see Plate 25*).

The *small sciatic*, 6, sends numerous branches round the

edge of the gluteus maximus, which radiate upwards and outwards from the point at which the nerve crosses the lower border of the muscle—viz., one that is immediately below the centre of the interval between the tuber ischii and the great trochanter.

The *external cutaneous*, 7, a branch of the lumbar plexus, lies with some fat, enclosed in an interval between two layers of the fascia lata. It enters the thigh internal to the anterior superior iliac spine, and runs vertically downwards, sending off posterior branches, 8, 8, which are distributed to the outer part of the thigh and the skin in front of the trochanter.

PLATE 32.

FIGS. 1 AND 2.

FIG. 1 shows the structures which are covered by the gluteus maximus. The incisions in the skin were almost the same as those which were employed in the preparation of the last Plate, but with these differences, that the anterior incision did not pass quite so far forward, and that the posterior was carried from the posterior superior spinous process to the tip of the coccyx. After removing the cutaneous vessels and nerves, and cleaning the gluteus maximus, the latter was reflected, and the parts beneath it were carefully cleaned. The fascia lata was completely removed from the surface of the gluteus medius and the posterior edge of the tensor vaginæ femoris. A small piece of the external oblique muscle of the abdomen was exposed, and a little of the fat from the posterior part of the ischio-rectal fossa was taken away.

Fig. 2 is a deeper view, taken more from the side, of the same region. In order to prepare it from the dissection shown in Fig. 1, the gluteus medius was taken away, with the vessels upon its surface, and the pyriformis was divided and turned aside. Then the great and small sciatic nerves, and the sciatic and pudic vessels, were similarly treated, the quadratus femoris was detached at its insertion and turned inwards, and the tendon of the obturator internus was cut, and the ends turned inwards and outwards. Lastly, the upper part of the vastus externus was shown, by removing the fascia superficial to it.

The reader will easily gather what structures lie beneath the gluteus maximus, and no enumeration of them will therefore be given. Three bursæ are described beneath the gluteus maximus, one over the great trochanter, another over the vastus

externus, and a third over the tuber ischii; only one, that over the vastus externus, Fig. 1, θ , was found in this subject. This was large and distinct, and like similar bursæ elsewhere, was traversed by numerous irregular bands. These bursæ are liable at times to be the seat of inflammation, and may then become filled with serum or pus. Other bursæ are found in this region; one often exists between the gluteus medius and the tendon of the pyriformis, Fig. 2, ι ; another occurs between the two smaller glutei, Fig. 2, μ , close to their insertions, and another is found beneath the gluteus minimus, between it and the surface of the great trochanter.

MUSCLES.

The *gluteus medius*, Fig. 1, A, arises from that part of the dorsum of the ilium which intervenes between the crest and the superior semicircular line above, and the middle semicircular line below, its origin extending forward as far as the anterior superior spine. It also takes origin from the fascia which is superficial to it, in front of the gluteus maximus. The fibres converge towards the great trochanter, the posterior ones being directed downwards and forwards, the anterior downwards and backwards, and they are inserted into the oblique impression which passes from the posterior superior to the anterior inferior angle of the outer aspect of the great trochanter. The muscle is covered by the fascia lata and the gluteus maximus, and the superficial part of the gluteal vessels cross it; it rests upon the gluteus minimus, and the tendon of the pyriformis, and the deep branches of the gluteal vessels and the superior gluteal nerves. The anterior border is slightly overlapped by the tensor vaginæ femoris, and both muscles arise from the intermuscular septum passing between them; as a result of which they appear to be very intimately blended together. The posterior edge corresponds to the upper edge of the pyriformis.

The muscle abducts the thigh; its anterior fibres rotate the

thigh inwards, the posterior outwards; but as the anterior set of fibres are the more oblique, and also the more numerous, its power of internal rotation is more marked than that of external rotation.

The *gluteus minimus*, Fig. 2, C, is, like the *gluteus medius*, a radiated muscle. It arises from the interval on the dorsum ilii between the middle and inferior semicircular lines. The fibres converge, like those of the *gluteus medius*, towards the great trochanter. The anterior pass downwards and backwards, and the posterior almost horizontally forwards to the insertion of the muscle, or to the anterior border of the great trochanter. The muscle is concealed by the *gluteus medius* and *pyriformis*, and is crossed by the deep branches of the gluteal vessels and by the superior gluteal nerve. It rests upon the ilium, the reflected head of the rectus, and the hip-joint. Its anterior border is parallel to that of the *gluteus medius*, and lies beneath the tensor vaginae femoris. Its action is the same as that of the *gluteus medius*.

The *pyriformis*, Fig. 1, B, arises from the anterior surface of the lateral parts of the middle three pieces of the sacrum—i.e., from the grooves which correspond to the second and third foramina, and from the ridges which separate these from one another, and from those corresponding to the first and fourth foramina. It also arises from the deep surface of the great sacro-sciatic ligament, and from the upper border of the great sciatic notch. The fibres are directed almost horizontally outwards, and are inserted on an impression at the upper border of the great trochanter.

The muscle is covered by the *gluteus maximus*, and at its insertion, by the *gluteus medius*. By its deep surface, it is in relation with the fascia of the *pyriformis*, with the sacral plexus and the branches of the internal iliac artery, and also with the *gluteus minimus*, the back of the ischium, and the hip-joint. On the left side the anterior surface of the muscle is in contact with the rectum. Its upper border is in

relation with the gluteus medius and the gluteal vessels and superior gluteal nerve; its lower with the gemellus superior, the sciatic and pudic vessels and nerve, and the nerve to the obturator internus. Its action is to rotate the thigh outwards, when the hip is extended; to abduct it, when the hip is flexed.

The *obturator internus*, Fig. 1, C, Fig. 2, F, is only seen in part, in the buttock. It arises from the inner surface of the pelvic wall—viz., from the obturator membrane—except a small part below, from the tendinous arch beneath the obturator vessels and nerve, slightly from the back of the body and of the arch of the pubes, but considerably from bone behind the obturator foramen; as it extends up to the brim of the true pelvis, and backwards to the great sciatic notch. It is attached, in addition, to the obturator fascia (*vide* page 220), covering it, especially where this is fixed to the bones, and also to the prolongation of the great sacro-sciatic ligament along the arch of the pubes.

The fibres converge towards the small sacro-sciatic foramen, near which the muscle becomes tendinous on its deep surface, and the broad tendon which results, turns at a right angle round the smooth surface of the notch. This tendon passes outwards towards the great trochanter, and after becoming more rounded, is inserted on a special mark at the fore part of the inner surface of the great trochanter. The tendon begins high up in the substance of the muscle by four or five strong bands, unequal in size, which appear on the deep surface, and converge towards the small sciatic notch. The intervals between these parts of the tendon form a number of grooves as it winds round the small sciatic notch. Each part has a corresponding groove on the cartilage which covers the notch, and between the cartilage and the tendon is a large synovial bursa, Fig. 2, η .

In the pelvis the muscle is in contact, externally with the bone and obturator membrane, internally with the obturator

fascia, and thus it occupies in part the lateral wall of the true pelvis, and in part the outer wall of the ischio-rectal fossa. In the buttock it is covered by the gluteus maximus and the sciatic vessels and nerves; the tendon runs under the pyriformis to its insertion. It rests in the groove formed for it by the two gemelli and the ischium; the gemellus superior lies along its upper border, the gemellus inferior along its lower. Its action is the same as that of the pyriformis.

The *gemelli* are two small muscles which have been sometimes described as forming a second head to the obturator internus. The *gemellus superior*, Fig. 1, D, Fig. 2, C, arises from the outer lip of the lower border of the ischial spine; and the *gemellus inferior*, Fig. 1, E, Fig. 2, H, from the upper and back part of the ischial tuberosity; they are situated respectively above and below, but also slightly beneath, the tendon of the obturator internus, and they join at their insertion the tendon of this muscle. Their action exactly resembles that of the obturator internus.

Bigelow, of Boston, in his work on "The Mechanism of Dislocation and Fracture of the Hip," describes the tendon of the obturator internus as dividing into minute pieces which pass through the fleshy fibres of the muscle to a bony attachment round the obturator foramen; and he maintains that this gives great strength to the muscle. That the muscle is stronger than the other rotators, there can be no doubt; and this causes it to play an important part in modifying the backward dislocation of the hip-joint. Thus, if the head of the bone slip out below the tendon of the obturator internus, it will be prevented from rising high on to the dorsum ilii, and the sciatic dislocation will result; if, on the other hand, it have escaped above the tendon, the ordinary dislocation on to the dorsum ilii will exist. The manner in which it acts in increasing the difficulty of the reduction of a sciatic dislocation is also pointed out in the very interesting book above mentioned, to which the reader is referred.

The *obturator externus*, Fig. 1, H, Fig. 2, K, arises from the inner half of the crural surface of the obturator membrane; from the anterior surface of the body and horizontal ramus of the pubes; and from the descending ramus of the pubes and ascending ramus of the ischium, along the margin of the obturator foramen. The fibres pass obliquely outwards and backwards, converging towards the neck of the femur, round the posterior aspect of which they are reflected at an obtuse angle, and, giving place to a strong tendon, are inserted into the bottom of the pit on the inner surface of the great trochanter.

The muscle is twisted in its course outwards, so that the surface, which looks forwards and downwards in front, is directed backward behind. Thus, the superficial aspect is in contact with the adductors magnus and brevis and the pectineus in front, and with the gluteus maximus and quadratus behind; while the deep surface touches at first the innominate bone and the obturator membrane, and then the neck of the femur and the hip-joint. The deep part of the obturator nerve perforates the upper part of the muscle. Its action is to rotate the thigh out in all positions of the hip-joint. It is also said to be an accessory flexor of the hip.

The *quadratus femoris*, Fig. 1, F, Fig 2, J, takes origin from a special impression on the outer surface of the ischial tuberosity, close to the posterior or lower border of the bone, and is inserted into a vertical but somewhat irregular line, called the *linea quadrati*, on the posterior aspect of the femur; its line of attachment above reaches just beyond the posterior intertrochanteric line. The anterior surface of the muscle is in contact with the obturator externus and the insertion of the psoas, the internal circumflex vessels, and the small trochanter; the posterior, with the tendon of the semi-membranosus, the sciatic nerves, and the gluteus maximus. The upper border corresponds with the inferior gemellus, the lower with the wide upper border of the adductor magnus. Its action is to rotate inwards, the femur outwards.

ARTERIES.

The *gluteal artery*, Fig. 1, *a*, Fig. 2, *a*, is a branch of the posterior division of the internal iliac. It leaves the pelvis above the pyriformis, and divides at once into a superficial (Fig. 1, *a*) and a deep (Fig. 2, *a*) branch. The former passes backwards between the pyriformis and gluteus medius, and is distributed in the substance of the gluteus maximus, some offsets becoming cutaneous on the buttock and sacrum; the latter runs forwards between the two smaller glutei, and divides into two main pieces for the supply of these muscles; one of these, Fig. 2, *b*, follows the middle semicircular line, and anastomoses with the external circumflex, while the other, Fig. 2, *c*, curves downwards and forwards towards the great trochanter, anastomosing in this region with the internal and external circumflex and the sciatic arteries; some branches end in the tensor vaginæ femoris.

The *sciatic*, Fig. 1, *b*, is a branch of the anterior division of the internal iliac artery. It leaves the pelvis below the pyriformis muscle, and follows the course of the sciatic nerves to the interval between the great trochanter and the ischial tuberosity; it then runs down the back of the thigh with the small sciatic nerve for a variable distance. This artery supplies a branch to the back of the sacrum and coccyx, called *coccygeal*, which perforates the great sacro-sciatic ligament and supplies many branches to the gluteus maximus; other special *muscular* branches Fig. 1, *c*, *c*, to the gluteus maximus, and the rotator muscles; a small branch (or branches) to the great sciatic nerve, *comes nervi ischiadici*, Fig. 1, *d*; a small *twig to the hip-joint*; *cutaneous* branches to the skin of the buttock and thigh; and an *anastomotic branch*, which was not present in this subject, but which is described as running outwards towards the pit on the great trochanter, to anastomose with the internal circumflex and gluteal.

The other arteries seen in this region are, the *pudic*, Fig. 1, *e*,

passing over the ischial spine to reach the ischio-rectal fossa, the terminal branches of the internal circumflex, and the first perforating branch of the profunda. Of the *internal circumflex*, Fig. 2, *e*, two parts are visible, one, Fig. 1, *g*, Fig. 2, *f*, at the upper border of the quadratus, close to the great trochanter, and the other, Fig. 1, *h*, Fig. 2, *g*, at the lower border of the quadratus beneath the great sciatic nerve. The former ascends to the pit in the great trochanter, where it anastomoses with the gluteal and sciatic arteries; the latter anastomoses with the first perforating. The *first perforating branch of the profunda*, Fig. 1, *k*, Fig. 2, *h*, pierces the adductor magnus near its upper border, and passes through the insertion of the gluteus maximus, to which muscle it is chiefly distributed; but it may send a few branches to the vastus externus and the skin. It anastomoses with the internal, and possibly with the external, circumflex arteries.

NERVES.

The full account of the *great* and *small sciatic nerves* will be reserved till the description of the back of the thigh is reached. The course of these nerves is from the great sacro-sciatic notch, at first downwards and outwards, and then vertically downwards, towards the interval between the great trochanter and the ischial tuberosity. The great sciatic nerve is covered by the gluteus maximus, and rests upon the ischium, the obturator internus and gemelli, the quadratus, and the adductor magnus. The small sciatic nerve supplies, in this region, numerous cutaneous branches, one of which, the *inferior pudendal*, Fig. 1, 4, passes to the perinæum, while others go to the back of the thigh, and others (Plate 31) to the skin over the gluteus maximus; it also furnishes in some cases the following:—The *inferior gluteal*, Fig. 1, 2, springing from the small sciatic, or independently from the sacral plexus (Plate 25, Fig. 1), and divides into a number of branches, which enter the gluteus maximus and supply it.

The *superior gluteal nerve*, Fig. 2, 2. For its source see Plate 25, Fig. 1, p. 234. It enters the buttock with the gluteal artery, and runs outwards between the two gluteal muscles, to both of which it supplies branches. One branch, 4, passes, generally beneath a slip of the *gluteus minimus*, to enter the deep surface of the *tensor vaginæ femoris*.

The following branches of the sacral plexus also make their appearance in this dissection. The *pudic*, Fig. 1, 8, Fig. 2, 7, with its accompanying artery, is seen as it crosses the ischial spine. One of its branches, Fig. 1, 7, Fig. 2, 8, the *inferior hæmorrhoidal*, is often separate from the main trunk, and lies alongside it in this situation. It is seen beyond the small *sacro-sciatic notch* in the perinæum in Fig. 1.

The nerve to the *obturator internus*, Fig. 2, 9, runs parallel to the pudic, and slightly external to it, and disappears by piercing the fibres of the *obturator internus muscle*. It usually furnishes the following branch.

The nerve to the *superior gemellus*, Fig. 2, 10, a minute twig lying underneath the great sciatic nerve.

The nerve to the *inferior gemellus and quadratus*, Fig. 2, 11, springs from the front of the sacral plexus and passes beneath the superior gemellus to supply a twig to the *inferior gemellus*, Fig. 2, 12, and another to the hip-joint, Fig. 2, 14; it breaks up into a number of branches, Fig. 2, 13, 13, for the supply of the quadratus.

We have seen in various dissections, branches of the *posterior primary divisions of the sacral nerves*; the accompanying woodcut may be taken as a moderately typical representation of their arrangement. Immediately after emerging from the posterior sacral foramina, these nerves are joined together in a series of loops, the first receiving a descending branch from the last lumbar, and the fifth sending down a similar one to the coccygeal or sixth sacral nerve. From these loops or from the nerves themselves, near their exit, small internal branches are given off to the *multifidus spinæ*. The arrangement of the fifth sacral is

precisely similar to that of the others except that it emerges beneath the ligament uniting the cornu of the coccyx to the sacrum, and that no internal branch is, as a rule, to be discovered.



Posterior Primary Branches of Sacral and Coccygeal Nerves.

- 5 l, Fifth Lumbar.
 1 i, First Sacral (internal branch). 1 e, First Sacral (external branch).
 2 i, Second " " " 2 e, Second " " "
 3 i, Third " " " 3 e, Third " " "
 4 i, Fourth " " " 4 e, Fourth " " "
 4 a, A Branch from the Anterior Primary Branch of Fourth Sacral.
 5, Fifth Sacral.
 6, Coccygeal Nerve or Sixth Sacral (undivided).
 6 a, Anterior Primary Branch of Coccygeal.
 6 p, Posterior " "
 4 5 6 a, Trunk formed by the Union of parts of the Anterior Primary Branches of the Fourth, Fifth, and Sixth (or Coccygeal) Sacral Nerves.

The coccygeal nerve emerges from the lower end of the sacral canal, runs internal to the cornu of the coccyx, and divides into an anterior and a posterior division; the latter, which corresponds to the series of nerves under discussion, after being joined by the descending part of the posterior branch of

the fifth sacral, sends a few small twigs outwards; the anterior division turns forward round the lower border of the first piece of the coccyx, and joins the trunk formed by twigs from the anterior primary divisions of the fourth and fifth sacral nerves. After joining in these loops near the sacral foramina, the upper four nerves pass outwards, and join in another series of loops beneath the most superficial layer of the great sacro-sciatic ligament, from which are given off cutaneous branches to the buttock.

Many different incisions have been recommended for the operation of *excision of the hip*, which it would be out of place to enumerate here. Most of them involve the tissues above, and somewhat behind, the great trochanter. One of the commonest, for example, begins at a point midway between the anterior superior iliac spine, and passes in a curve, the convexity of which is backwards, behind the great trochanter, extending downwards for a variable extent. Through such an incision the upper part of the neck of the femur and the outer part of the great trochanter may easily be reached. It will be obvious, from a study of this and the preceding Plates, that while the insertions of the gluteal muscles will be more or less interfered with, there is no vessel or nerve of any consequence which is liable to injury.

A bony landmark for the gluteal artery is sometimes required. The posterior superior spine of the ilium is easily felt; the posterior inferior spine is about an inch and a half lower down, and marks the commencement of the great sciatic notch, through the upper part of which the gluteal artery makes its appearance. The position of emergence of the great sciatic nerve may also be readily ascertained by reference to these two points, the width of the pyriformis separating it from the gluteal artery.

PLATE 33.

FIG. 1.

THIS dissection illustrates the cutaneous vessels and nerves of the front of the thigh, and the anatomy of *Scarpa's triangle*.

An incision was made on the front of the thigh from the middle of Poupart's ligament to the middle of the patella; and this was crossed at the upper extremity by one running along Poupart's ligament from end to end, and below by a transverse one, which half encircled the limb. The cutaneous vessels and nerves were carefully dissected, and the superficial fascia was completely removed, so as to expose the fascia lata. The fascia lata was then taken away in the upper third of the thigh from an area bounded externally by the outer border of the sartorius, internally by the inner border of the adductor longus, and above by Poupart's ligament. Lastly, the fat, cellular tissue, glands and crural sheath, were removed from Scarpa's triangle, so as to expose the structures contained in this space.

ARTERIES.

The cutaneous arteries of the front of the thigh are derived from the femoral. At the upper part are four named branches, the *superficial epigastric*, *d*, the *superficial circumflex iliac*, *e*, the *superficial external pudic*, *f*, and the *deep external pudic*, *g*. These have been previously described at p. 187. The *superficial branch of the anastomotic* (Plate 36, Fig. 2, *b*), accompanies the saphenous nerve.

VEINS.

The superficial veins of this region join the *internal saphenous*, β . This large vein runs from the hinder and inner part of

the knee upwards to the saphenous opening, through which it passes to join the femoral vein.

The saphenous vein is often varicose. The varicosity may affect the lower part, or the whole, of the vessel ; or occasionally, it consists of a single dilatation over the saphenous opening. The latter condition bears a certain resemblance to a femoral hernia, from which, however, it may easily be distinguished by the fact that, after reduction, the swelling re-establishes itself while pressure is maintained over the saphenous opening ; and also by the *bruit* which is transmitted to the finger if placed upon the tumour when the patient coughs.

The fascia lata is described at p. 190 and p. 276.

NERVES.

The cutaneous nerves of the front of the thigh are derived in part from two branches of the anterior crural : the middle and internal cutaneous ; and in part from the following branches of the lumbar plexus : the external cutaneous, the genito-crural, the ilio-inguinal, and sometimes the superficial part of the obturator.

The *external cutaneous*, 9, is derived from the second, or the second and third lumbar nerves, and enters the thigh by passing beneath Poupart's ligament near the anterior superior spinous process of the ilium. Its course is vertically downwards, and it is found with some small cutaneous vessels and some fat, between two layers of the fascia lata. It soon divides into two branches—the posterior and the anterior ; the former reaches the outer part of the buttock and the back of the outer part of the thigh ; the latter runs vertically downwards to end in the plexus patellæ. This nerve often enters the thigh at a point considerably nearer the vessels than that indicated above ; it often, as was the case in the subject from which the drawing was made, supplies a large branch, 6, which takes the place of the outer piece of the middle cutaneous.

The *crural branch of the genito-crural*, 8, enters the thigh in the crural sheath, and becomes cutaneous by piercing this structure, and the fascia lata, just below Poupart's ligament and immediately outside the femoral artery. It is directed downwards, but it sends branches inwards and outwards, and joins the middle cutaneous. It supplies the skin of the middle of the upper half of the thigh.

The *ilio-inguinal*, 10, a branch of the first lumbar nerve, emerges with the spermatic cord through the external abdominal ring, and sends small twigs to the upper and inner parts of the thigh, and to the scrotum or labium.

The *middle cutaneous*, 5, a branch of the anterior crural, supplies two large branches (in this case the outer, 6, came from the external cutaneous), which run down the middle of the front of the thigh as far as the knee, and help in the formation of the patellar plexus. These nerves pierce the fascia in the upper third of the thigh, and one, as will be afterwards seen, generally perforates and supplies the sartorius muscle.

The *internal cutaneous*, 2, crosses the femoral artery in Scarpa's triangle as one or two trunks. Its first cutaneous branch is a slender twig, 3, appearing in the line of the vessels about the apex of Scarpa's triangle, and running down as far as the middle of the thigh. The large *anterior branch*, 4, perforates the fascia lata about the middle, and runs down to the knee, where it joins in the plexus patellæ. The *posterior branch*, Fig. 2, 3, pierces the fascia lata in the lower third of the thigh, and runs down to supply the skin at the inner and back part of the knee, occupying a position behind that of the internal saphenous nerve. (Plate 36, Figs. 1 and 2.)

The *internal saphenous*, Plate 36, Fig. 2, 5, can hardly be reckoned amongst the cutaneous nerves of the thigh. Its *patellar branch*, Plate 36, Fig. 2, 4, pierces the sartorius muscle in company with a twig from the anastomotic artery, and runs

down to the knee-joint parallel with, but slightly behind, the anterior branch of the internal cutaneous, which it joins. Ultimately, it turns forwards at the level of the patella, to join in the formation of the patellar plexus. The course of the saphenous nerve through the thigh will be seen in Fig. 2, and its final distribution will appear in the dissections of the leg.

The size of the nerves just enumerated varies considerably, as they often more or less replace one another. The genito-crural, for example, is often very minute ; at other times it may be considerably larger than it was here found to be. The *obturator* nerve always joins the posterior branch of the internal cutaneous, and may take its place, in part, or altogether.

The *plexus patellæ*, formed by the union of the external, middle and internal cutaneous, with the patellar branch of the saphenous, in front of the knee, is shown in Plate 36, Fig. 2.

Scarpa's triangle is the name applied to the hollow between the muscles at the upper part of the thigh. It is a hollow triangular pyramid flattened from before backwards, the base of which is directed upwards, and corresponds to the interval between Poupart's ligament and the subjacent muscles. The apex is formed by the meeting of the inner borders of the sartorius and the adductor longus, and is situated at the junction of the upper and middle thirds of the thigh. Of the three sides, the outer is formed by the psoas and iliacus ; and the inner by the pectineus and the adductors longus and brevis, the latter, however, appearing only to a very slight extent between the two muscles which are in front of it ; the anterior wall consists of the fascia lata.

In this space are contained the femoral vessels enclosed in the crural sheath (*see* p. 191), the vein lying at first internal to the artery, but afterwards being behind it. The artery disappears beneath the sartorius, external to the apex of the triangle ; it gives off the profunda and some superficial branches in this part of its course. Outside the artery, and separated

from it by some fibres of the psoas muscle, is the anterior crural nerve, which breaks up into its various branches whilst it lies in Scarpa's triangle, one of which, the internal cutaneous, is seen to cross the artery, while another, the nerve to the pectineus, passes behind the vessels. The remaining space is filled by a large quantity of loose fat and some lymphatic glands.

The exact relations to one another of the important structures occupying this space, must of course be borne carefully in mind during the performance of operations for the removal of tumours of this region, or for the relief of the stricture in a case of obturator hernia. The question of the ligature of the femoral artery will be referred to when the whole course of this vessel has been described.

Reference has already been made (p. 173) to the course which is taken by a *psoas abscess* which descends into Scarpa's triangle. It will be remembered, that if it points at the inner part of the thigh, the femoral vessels lie over the middle of the sac.

The *lymphatic glands* which are arranged along the course of the femoral vessels, draw their supply of lymph from the whole of the lower extremity, with the exception of the buttock, whence the lymphatic vessels pass, for the most part, to the series of glands along Poupart's ligament.

FIG. 2.

The dissection shown in Fig. 2 was made from the preceding, by removing the fascia lata and all the cutaneous nerves, except those derived from the internal cutaneous, the internal saphenous, and the obturator; and afterwards taking away the greater part of the sartorius and cleaning the structures thus exposed. Almost the whole of the aponeurosis which

forms the roof of Hunter's canal was removed, so as to exhibit the structures which occupy this space.

The *sartorius* is partly shown in this Plate, Fig. 1, A, Fig. 2, A, and partly in Plate 36. It arises from the anterior superior spine of the ilium, and from the upper half of the notch that intervenes between the two anterior iliac spines. It is tendinous at its origin, but the tendon soon gives place to a flat muscle from two to three inches broad, which is directed at first downwards and inwards, then perpendicularly downwards, and at last, near its insertion, where it again becomes tendinous, almost horizontally forwards towards the tubercle of the tibia. The tendon of insertion is thin and broad, and is attached to the upper part of the inner surface of the tibia, partly to a vertical line on a level with, but internal to, the tubercle, and partly to a horizontal line running backwards from the upper extremity of the former. The muscle is subcutaneous in its whole extent. It rests upon the tensor vaginæ femoris, the rectus, the iliacus, on branches of the anterior crural nerve, and on the femoral vessels with many of their branches, the vastus internus and the adductors longus and magnus; and its insertion covers the tendons of the gracilis and the semitendinosus, and is in contact with the internal lateral ligament of the knee-joint. The patellar branch of the saphenous nerve, and often a branch of the middle cutaneous nerve, perforate the muscle. Its action is to flex the hip and the knee, imparting to the thigh a rotation outwards, and to the tibia a rotation inwards. A bursa is found between its tendon of insertion and those of the gracilis and semitendinosus.

The *triceps extensor cruris* consists of three parts—the rectus, the vastus externus, and the vastus internus.

The *rectus femoris*, I, is a pennisiform muscle. It arises by two strong tendinous heads, one of which is attached to a mark at the upper part of the acetabulum; and the other to the

anterior inferior spinous process of the ilium. From the union of these two heads there results a strong tendon, which runs down on the anterior surface and in the middle of the muscle, as far as the middle of the thigh. From this tendon the muscular fibres diverge, and form a thick fleshy belly, which ends below in another very strong tendon. This lower tendon extends upwards a considerable distance on the posterior surface of the muscle, and is attached below to the upper border of the patella, after blending with the tendons of the two vasti from both of which it receives some fleshy fibres. It sends a thin fibrous layer downwards over the anterior surface of the patella to join the *ligamentum patellæ*. The rectus is covered above by the sartorius, the tensor vaginæ femoris, and the gluteus minimus; below it is uncovered by muscle. It rests upon the vastus internus, the vastus externus, and the hip-joint.

The *vastus externus*, J, arises from the highest part of the anterior surface of the femur in the angle between the anterior border of the great trochanter and the commencement of the spiral line, from the root of the great trochanter, from the posterior surface of the bone outside the line leading from the great trochanter to the linea aspera and the upper half of the linea aspera itself, and also from the intermuscular septum. The origin is about three-quarters of an inch wide at the upper part, and about a quarter of an inch wide at the lower. The muscle is tendinous on the outer surface above, and becomes tendinous on its under surface below. Its fibres are directed downwards and slightly forwards, and it is inserted into the tendon of the rectus and into the upper and outer part of the patella; from the outer border is given off a fibrous expansion which blends with the capsule of the knee-joint. It is covered above by the tensor vaginæ femoris and the aponeurotic insertion of the gluteus maximus, but for the rest of its extent it is subcutaneous; it rests upon the

vastus internus and the femur, and upon some branches of the external circumflex vessels. Below, it is intimately blended with the outer part of the *vastus internus*.

The *vastus internus*, H, arises from the anterior, inner and outer surfaces of the upper three-fourths of the femur, in the following way. Internally, it reaches the inner lip of the *linea aspera* and the lines prolonged from it upwards to the spiral line, and downwards to the line passing to the internal condyle; externally, its origin is bounded by the line leading from the external condyle to the *linea aspera*, by the lower half of the outer lip of the *linea aspera*, and by a line drawn parallel to, but a short distance in front of, the line of attachment of the *vastus externus*; it also arises from the tendons of the *adductors longus* and *magnus*. It is not, however, attached to the whole of the space included between these limits, for if the *rectus* be turned down from it, an interval will be seen in the tendon of the *vastus internus*, which if followed up will be found to separate the muscle into two tolerably distinct parts (formerly described as *vastus internus* and *crureus*), see Plate 34, Fig. 1. The origins of these parts blend above, but are separated almost as high as the spiral line by an interval half an inch or more in width, along the inner surface of the femur, to which no muscle is attached. The inner origin forms a narrow vertical band; the outer is much broader, but is interrupted by oblique lines from which no muscular fibres take origin.—The central fibres are directed vertically downwards; the inner obliquely downwards and forwards above, almost horizontally forwards below; the outer fibres are also directed downwards and forwards. Some of the muscular fibres end on the tendon of the *rectus*, the rest unite in a broad tendon which in part blends with that of the *rectus*, and is in part attached beneath it, to the upper and inner borders of the *patella*; it also sends, like the *vastus externus*, a fibrous

expansion to the capsule of the knee-joint. The muscle rests upon the femur, and superficially it is in contact with the vastus externus, the rectus, the sartorius, the femoral vessels, the iliacus, the pectineus, the adductor longus and adductor magnus; branches of the anterior crural nerve and external circumflex vessels cross it.

The *ligamentum patellæ* is the common tendon of insertion for the whole of the triceps extensor. This is much stronger than any of the tendons which have been already described; it is attached above to the apex and lower border of the patella, and below to the lower part of the tubercle of the tibia. It is covered by the anterior part of the capsule of the knee, to which articulation it stands in the place of an anterior ligament.

Beneath the vastus internus is a small muscular slip, the *subcrureus*, Plate 34, Fig. 1, A', which takes origin from the lower part of the anterior surface of the femur, and is inserted into the synovial membrane of the knee-joint.

The action of the triceps is to extend the knee-joint, but the rectus has in addition the power of flexing the hip.

Of the *adductors*, two are now pretty fully visible, the other members of this group will be described in connection with the following Plate.

The *pectineus*, C, arises from the pectineal line, and from the posterior part of the triangular surface in front of it. The fibres are directed downwards, outwards, and backwards, and are inserted behind the psoas and iliacus, into the upper half of the line leading from the small trochanter to the *linca aspera*. The muscle is crossed by the femoral and profunda vessels; it rests upon the pubes, the pubio-femoral ligament of the hip-joint, the obturator externus, and the adductor brevis, and part of the obturator nerve. Its outer border corresponds to the psoas, its inner is separated by a narrow triangular interval

from the adductor longus. The muscle acts as an adductor of the thigh, and a flexor and rotator out of the hip.

The *adductor longus*, D, arises from a somewhat triangular impression, included in the angle between the crest and symphysis of the pubes. The origin consists of a strong roundish tendon, which soon becomes wider and flattened, and gives place to a triangular muscle, which passes downwards and outwards, and somewhat backwards, and again becoming tendinous it is inserted into the whole length of the inner lip of the linea aspera. The aponeurotic insertion is intimately blended with the vastus internus and the adductor magnus. It is crossed by the sartorius, and by the femoral vessels and the saphenous and internal cutaneous nerves, and is overlapped by the vastus internus. It rests upon the adductors brevis and magnus, on the profunda vessels, and on branches of the obturator nerve. Its outer edge almost corresponds with the pectineus, its inner edge in the upper part touches the gracilis. The muscle acts as an adductor of the thigh, and a flexor and rotator out of the hip-joint.

Uniting the vastus internus with the conjoined tendons of the adductors longus and magnus is an aponeurotic layer, †, the *femoral aponeurosis*, which completes with these muscles a canal called *Hunter's canal*. The aponeurosis has a distinct free lower margin, from beneath which the internal saphenous nerve and the superficial branch of the anastomotic artery make their appearance; above, it becomes much thinner and gradually disappears. The canal is triangular in transverse section, and contains the femoral vessels and the internal saphenous nerve.

ARTERIES.

The *femoral artery*, b, occupies the upper three-fourths of the thigh, entering it beneath Poupart's ligament, and leaving it by passing through the opening in the adductor magnus. Its

direction will be indicated on the surface of the limb by drawing a line from a point midway between the anterior superior spine of the ilium and the symphysis pubis, downwards to the tuberosity on the inner condyle of the femur, when the thigh is abducted, slightly flexed and rotated out. It is divided, for the sake of description, into two parts: the upper, the superficial femoral, contained in Scarpa's triangle; the lower or deeper, contained in Hunter's canal.

The superficial femoral is about four inches long, and is enclosed, in the upper part of its extent, by the crural sheath (Plate 20, Fig. 1, p. 191). It is covered only by the integumental structures, and is crossed by one or two branches of the internal cutaneous nerve, and by some superficial veins. It lies over the psoas and the pectineus muscles, but is separated from the latter by the profunda vessels, and partly by its own vein and the small nerve to the pectineus. The anterior crural nerve lies to its outer side, separated from it by a few fibres of the psoas, and the femoral vein is behind it at the apex of Scarpa's triangle, but is in close contact with its inner side near Poupart's ligament.

The deep part of the artery is contained in Hunter's canal, and is longer than the superficial portion. It is covered by the femoral aponeurosis, by the sartorius, and by the integuments; and is accompanied by the internal saphenous nerve, which crosses it obliquely from without inwards. It rests upon the adductors brevis, longus, and magnus, and upon its own vein, which appears slightly to its outer side, near the opening in the adductor magnus. To the outer side of the artery is the vastus internus.

In Scarpa's triangle the femoral artery gives off four superficial branches (shown in Pl. 19, Fig. 1, pp. 186, 187), and also the *profunda*, *g*, which will be described in connection with the following Plate. In Hunter's canal cutaneous branches arise from its inner side, and muscular

branches to the sartorius and adductors; and from its outer side a series of large muscular trunks are given off,* which run downwards and outwards in the substance of the vastus internus, and supply cutaneous twigs to the front of the thigh; close to its termination the following named branch appears, which may be looked upon as the lowest of this series.

The *anastomotica magna* (Plate 34, Fig. 1, q, r,) leaves the femoral trunk near the opening in the adductor magnus, and divides immediately into a superficial and a deep branch. The former, *k*, usually appears with the internal saphenous nerve, from beneath the free border of the aponeurosis forming the roof of Hunter's canal, and accompanying the saphenous nerve for some distance, is distributed to the inner part of the knee and the upper and inner part of the leg. The deep branch (Plate 34, Fig. 1, q) runs vertically downwards in the fibres of the vastus internus, along the tendon of the adductor magnus, accompanied usually by a small articular twig from the nerve to the vastus internus, as far as the inner side of the knee-joint, where it anastomoses with the other articular arteries in this situation. It sends a transverse branch across the front of the lower part of the femur to anastomose with a corresponding branch of the upper external articular branch of the popliteal artery.

The *femoral artery* is usually *ligatured* either just below the apex of Scarpa's triangle, or at the lower part of Hunter's canal. In the former case, an incision three or four inches long is made in the course of the vessel through skin, and superficial and deep fasciæ, the central point of which should be four inches below Poupart's ligament. The fascia lata is then raised from the sartorius until the inner border of the muscle is exposed, when this is pulled outwards with a blunt hook or

* One of these, *i*, is often found just below the point at which the ligature is usually applied. The size and number of these muscular branches varies inversely with the size of the profunda.

retractor, and the position of the vessel accurately determined with the finger-tip. It only remains to make a small opening in the sheath of the artery, and pass the needle from the outer side. In tying the femoral artery in Hunter's canal, an incision is made of the same length and on the same line, or rather farther inwards, and the mid-point of which should be about half-way down the thigh. After dividing the skin and fasciæ the sartorius is exposed, when the fascia lata is so raised as to expose the outer border of the muscle, which is then pulled inwards. A free incision* is made in the femoral aponeurosis, and a small opening in the sheath of the artery, after which, as in tying the superficial femoral, the needle is passed from the outer side, the object in both cases being to avoid the vein, which it must be remembered is in very close proximity to the artery. In the lower operation the surgeon must take care not to include the saphenous nerve in the ligature. The upper ligature is applied *below* the apex of Scarpa's triangle, because this is the first point which is certain, or almost certain, to be below the origin of the profunda artery, which vessel arises occasionally as low down as four inches below Poupart's ligament; but if an aneurism occur in the femoral trunk, it may be necessary to tie the vessel in the upper part of Scarpa's triangle.

VEINS.

The *femoral vein*, α , lies at first behind its companion artery and slightly to the outer side; at the upper part it passes to the inner side. It receives numerous muscular tributaries, as well as the *profunda vein*, γ , and the *internal saphenous*, β .

NERVES.

The *anterior crural*, 1, is derived from the lumbar plexus. As it passes beneath Poupart's ligament it is embedded between

* If this incision be not a free one and suppuration occur, pus may be conducted by the aponeurosis down into the ham and much mischief result.

the psoas and iliacus muscles. The nerve immediately breaks up into a number of cutaneous and muscular branches, of which the former, with the exception of the internal saphenous, as a rule, leave the trunk in front of the latter.

The *middle cutaneous*, 4, and *internal cutaneous*, 2, 3, have been described, p. 295. The *internal saphenous*, 5, is now seen to approach the femoral artery near the apex of Scarpa's triangle, and to cross the vessel in Hunter's canal. As it leaves Hunter's canal it gives off one or two twigs, 6, 6, which enter into a loose plexus beneath the sartorius with the posterior branch of the internal cutaneous, 3, and the cutaneous branch of the superficial part of the obturator, 14.

The *muscular branches to the sartorius* are derived from the middle, or sometimes the internal, cutaneous. The branch or branches to the *pectineus*, 11, pass beneath the femoral artery, and are often given off together with the internal cutaneous. The other muscular branches, 8, 9, 10, *supply the rectus, the vastus internus, and the vastus externus*. From the nerve to the vastus externus is generally given off a small articular twig which runs downwards along the anterior border of the muscle to the knee; and from the nerve to the vastus internus arises a similar small twig which usually accompanies the deep branch of the anastomotic artery; but the position of these nerves is not constant.

PLATE 34.

FIG. 1.

THE dissection for this drawing was made from one carried to the same point as that shown in Fig. 2 of last Plate in the following way. After removing the remains of the femoral aponeurosis and the nerves which cross the femoral vessels, the latter are to be cut below the origin of the profunda and above the opening in the adductor magnus, and the intervening portion taken away. The upper part of the vessels—i.e., that between the origin of the profunda and Poupart's ligament—is also to be taken away in order to show more clearly the psoas and the internal circumflex artery. The rectus is then removed, the vastus externus is separated from the vastus internus, and then the inner part of the vastus internus* was taken away, the nerves to the rectus and vastus internus being divided, and the muscular branches of the anterior crural nerve are dissected out, with the three divisions of the external circumflex artery. Lastly, the pectineus and the adductor longus are to be divided, and in great part removed, their cut ends being turned out of the way, and in this manner exposing the adductors brevis and magnus and the obturator externus in part, the profunda vessels and their perforating branches, the whole of the superficial part of the obturator nerve, and some of the branches of the deep part.

* If the tendon of the rectus be raised from the combined aponeurosis of the vastus internus and externus, a small *interval* in the latter will be found near the upper and inner angle of the patella. If the knife be introduced into this and the muscle divided above it, an interval will be found in the muscle corresponding to a broad piece of the femur from which no muscular fibres arise. The inner part is the vastus internus proper, the outer part the crureus; in the space between the two is seen the inner part of the subcrureus and a nerve passing down to supply it.

MUSCLES.

The *adductor brevis*, E, has a fleshy and tendinous origin from the body of the pubes between those of the gracilis and that of the obturator externus. The fibres pass downwards and outwards, the muscle widening as it descends, and it is inserted behind the pectineus into the whole of the line leading from the small trochanter to the linea aspera. In front of the adductor brevis are the adductor longus, the pectineus, and the superficial part of the obturator nerve, and it enters partly into the formation of the inner side of Scarpa's triangle;* the posterior surface touches the obturator externus, the adductor magnus, branches of the internal circumflex vessels, and the deep part of the obturator nerve. Its action is that of a flexor and adductor of the hip-joint.

The *adductor magnus*, F, arises from the outer edge of the rami of the ischium and pubes external to the origins of the adductor brevis and gracilis and internal to that of the obturator externus, it is also attached to the lower part of the ischial tuberosity. It is inserted into the femur along the line which leads downwards from the lowest part of the insertion of the quadratus femoris to the linea aspera, to the middle lip of the linea aspera, and to the line leading from the linea aspera to the internal condyle as far as the groove for the femoral vessels; below this groove it is attached by a thin aponeurosis to the greater part of that which remains of the line leading from the linea aspera to the internal condyle, and also by a strong tendon to a tubercle upon the inner condyle of the femur. The origin from the rami of the pubes and ischium is

* The origins of the adductor longus and pectineus touch one another at the pubic spine, their insertions are separated by the lower half of the line leading from the linea aspera to the small trochanter; there is thus a triangular piece of the anterior surface of the adductor brevis uncovered by either of these muscles, and it is the inner part of this which forms the floor of Scarpa's triangle.

by fleshy and tendinous fibres, and these spread out in a fan-shape, and are principally inserted into the *linea aspera* and the line above it. The origin from the *tuber ischii* is chiefly *tendinous*; the fibres of this part of the muscle are almost vertical and end for the most part in the strong tendon which passes down to the inner condyle of the femur. The insertion of the anterior part of the muscle is tendinous in front, where it is closely united to the *adductors longus* and *brevis* and to the *vastus internus*, but it is fleshy behind. It presents several openings close to the femur for the passage of the perforating arteries, the highest of which is the most distinct; at the lower part, is a large opening for the passage of the femoral vessels, the inner side of which is formed by the strong vertical tendon, and the outer by the femur and the *vastus internus*.

In contact with the anterior surface are the *adductors brevis* and *longus*, the *profunda* and femoral vessels, and the long *saphenous* and *obturator* nerves; near the condyle of the femur, the *vastus internus* is in front of the tendon of the *adductor magnus*, and may almost be said to take origin from it. The posterior surface of the muscle is in contact with the *gluteus maximus* and the hamstrings, and with the great sciatic nerve. Its upper border is thick, and is in relation first with the *obturator externus* and then with the *quadratus femoris*, the transverse branch of the internal circumflex artery crosses over it; its inner border is partly subcutaneous and is partly in contact with the *gracilis*, and partly with the *sartorius*.

The principal action of the muscle is that of an adductor of the thigh; the anterior or upper part of it will also flex the thigh and rotate it out. The posterior or lower part, which may almost be looked upon as belonging to the same class as the hamstrings, extends the hip and may rotate the thigh somewhat inwards.

The anterior surface of the *obturator externus*, N, the insertion of the *psoas and iliacus*, L and M, and the arrangement of the two parts of the *vastus internus*, A, A, and their relation

to the *subcrureus*, A', are shown in the drawing. The description of these muscles will be found elsewhere.

ARTERIES.

This dissection displays the *profunda*, l, and some part of each of its branches. The profunda arises from the outer and posterior aspect of the femoral trunk, usually at a distance of about an inch and a half from Poupart's ligament; but the point of its commencement varies considerably, sometimes it may spring from the external iliac artery, sometimes as low as four inches below the commencement of the femoral. It is directed at first downwards, and then downwards and inwards, so that it crosses beneath the femoral artery, though separated from it by its own and the femoral veins, resting meanwhile upon the iliacus, and slightly upon the pectineus and adductor brevis. It then passes between the adductor longus and the adductor brevis, and below the insertion of the latter muscle it lies between the adductor longus and the adductor magnus, and ends by passing into the substance of the last muscle just above the opening for the passage of the femoral vessels. The artery lies very close to the femur and supplies the following branches:—

The *external circumflex*, h, is a large vessel, which runs transversely outwards beneath the sartorius and rectus and the divisions of the anterior crural nerve, and soon divides into three sets of branches, ascending, transverse, and descending. The *ascending*, i, pass upwards beneath the tensor vaginæ femoris, and anastomose with the terminal branches of the gluteal. The *descending*, k, are large, and pass down between the vastus externus and the vastus internus towards the knee, supplying offsets to both muscles on their way. Others of this set supply the outer part of the knee anastomosing with the other articular branches in this situation. The *transverse branch*, j, passes beneath the vastus externus to the back of the thigh;

it supplies muscular offsets to the vastus, and anastomoses with the internal circumflex and first perforating arteries, and with small twigs of the gluteal and sciatic in the pit of the trochanter. The external circumflex is often derived from the femoral; rarely from the external iliac.

The *internal circumflex, e*, like the external circumflex, often arises from the femoral, occasionally from the external iliac. Its usual seat of origin is from the commencement of the profunda, close to that of the external circumflex. It winds round the upper part of the femur in the direction of the small trochanter, lying at first between the psoas and pectineus, and then between the pectineus and obturator externus, keeping above the level of the adductor brevis, and dividing into its terminal branches on the anterior surface of the quadratus femoris. The vessel gives ascending and descending branches to the muscles between which it passes, some twigs to the upper end of the femur, and a small *branch to the hip-joint, f*; some of these anastomose with branches of the obturator artery. Of the two terminal branches, the *ascending* passes between the obturator externus and the quadratus femoris, and reaches the pit in the great trochanter, where it anastomoses with the other arteries in this situation; the *transverse branch* passes to the hamstrings between the quadratus and the adductor magnus, and anastomoses with the perforating arteries.

The *perforating arteries, m, n, o*, are described as three or four, but their number is liable to considerable variation. The upper one, *m*, is pretty constant and leaves the profunda close to the lower border of the pectineus, it pierces the adductors brevis and magnus, and winding round the femur in close proximity to the bone, is finally distributed in the lower part of the gluteus maximus and in the vastus externus and the hamstrings. It anastomoses with the external and internal circumflex arteries and with the sciatic. The second and third per-

forating arteries are smaller in size and arise lower down from the profunda; they take a similar course round the femur. The second perforates the adductors brevis and magnus and the short head of the biceps, to end in the vastus externus, it supplies branches to the hamstrings and the nutrient vessel of the femur. The third perforates the adductor magnus and the biceps, and ends like the second. The terminal branch of the profunda is sometimes called the fourth perforating; it passes through the same muscles as the third, just above the opening for the femoral vessels, and is distributed to the vastus externus and the hamstrings.

The profunda supplies numerous muscular branches, which are directed inwards and backwards through the adductor magnus.

NERVES.

The muscular branches of *the anterior crural* are here displayed. (*Vide* p. 306.)

The *obturator nerve*, 16, is a branch of the lumbar plexus, being derived from the third and fourth lumbar nerves. It may be seen in Fig. 2, 10, passing downwards behind the brim of the pelvis, to reach the opening at the upper part of the obturator foramen, through which it passes in company with the obturator artery. After leaving the pelvis it divides into two branches, a superficial and a deep; the superficial branch supplies the adductors longus and brevis and the gracilis, and sends a cutaneous branch to the inner part of the thigh. The deep branch pierces the obturator externus, which muscle it supplies together with the adductors magnus and brevis; a long delicate branch extends downwards in the substance of the adductor magnus, to join the main artery of the limb as the vessel is passing through the opening in the muscle, and passing on the artery towards the back of the knee, it pierces the posterior ligament to supply the articulation. Before the nerve

leaves the pelvis it supplies a twig to the hip-joint, which is often described as coming from the superficial part.

FIG. 2.

This dissection is intended to show the relation to one another of the structures in the pelvis and at the upper part of the thigh; and as everything here shown has been described elsewhere, it is only necessary to give an account of the method of making the dissection.

After the lower part of the body had been separated from the upper above the level of the fourth lumbar vertebra, a cut with a fine saw was made as nearly as possible in the middle line so as to divide the former into two equal halves. The rectum and bladder were then removed, the vessels and nerves supplying them being divided, and the remains of the split corpus spongiosum taken away with the bladder. Then the levator ani was exposed and taken away, with the exception of its origin from the back of the pubes, B, in this way laying bare the fat of the ischio-rectal fossa. The branches of the internal iliac artery and the sacral plexus were cleaned at the posterior and upper part of the dissection, and the fascia was removed from the surface of the obturator internus and coccygeus; on taking away the fat of the ischio-rectal fossa, the branches of the pudic vessels and nerves and the erector penis were displayed. The skin of the upper and inner part of the thigh was now removed by means of two incisions carried vertically downwards, one in front from the spine of the pubes, and the other behind from the tip of the coccyx. These incisions extended downwards for a third of the length of the thigh, and their lower ends were joined by a transverse cut. In this area the vessels and nerves in the superficial fat were first dissected, and then the fascia lata was cleaned and removed from the subjacent muscles.

There are two or three points in connection with this figure to which attention may be drawn. It will be noticed that, as occasionally happens, the sciatic artery is not coming off from the anterior division of the internal iliac, and that it is passing behind the cords of the sacral plexus, so that the only vessel in front of the nerves, in this case, is the pudic. It will be also seen that the pubic origin of the levator ani is a long one; not only did it reach as far as the notch at the upper part of the obturator foramen, but some of the muscular fibres took origin from the ligamentous band passing beneath the vessels and nerves. Piercing this origin of the levator ani is a small arterial branch, uniting the obturator to the artery of the corpus cavernosum. The vessels and nerves which occupied the ischio-rectal fossa lost their support when the fat from this region was removed, and it is needless to state they could not be replaced with certainty in their actual position.

PLATE 35.

FIG. 1.

THIS dissection exposes the superficial muscles at the back of the thigh. An oblique incision was made from the junction of the sacrum and coccyx, downwards and outwards to just below the great trochanter ; a transverse one was carried round the back of the knee, above the condyles of the femur, so as to half encircle the limb ; and the inner and outer extremities of these were joined by two vertical incisions. After defining the superficial nerves and vessels shown in the drawing, the fascia lata was removed completely from such parts of the gluteus maximus, the hamstrings, the gracilis, and the sartorius as were exposed by the incision, and was partially taken away from the surface of the vastus externus. The fat of the popliteal space was not interfered with, but the muscles, vessels, and nerves which lay beneath the fascia were carefully cleaned.

MUSCLES.

Of the muscles here seen, none are completely laid bare. The three hamstrings alone require description.

The *biceps*, B, arises by two heads, of which the long one principally is seen in this view, but some of the fibres of the short head are visible as they blend with the tendon at the lower part of the dissection. The long head arises, in common with the semitendinosus, from a special mark on the posterior and inner part of the ischial tuberosity, internal to the origin of the semimembranosus. This origin is narrow and tendinous, but soon gives place to a stout fleshy belly, which ends in a strong tendon, wide at first, but rounded below, into the upper

part of which the short head is inserted. This tendon passes downwards to the upper end of the fibula, and is attached to the outer and upper part of the head of this bone. It is inserted by two slips, which are fixed on each side of the insertion of the long external lateral ligament. It also sends a prolongation inwards to the front of the external tuberosity of the tibia, and from the posterior border a strong expansion is given to the fascia of the leg. The short head is almost entirely concealed by the long head; it has a fleshy origin from the outer lip of the linea aspera, from the greater part of the line which leads from this to the external condyle, and from the external intermuscular septum. The muscle is subcutaneous, except at its origin, where it is covered by the gluteus maximus. It rests upon the semimembranosus, the adductor magnus, and the vastus externus; it also covers part of the sciatic nerve, and it occupies the space between the vastus externus and the semitendinosus. A bursa is commonly found between the tendon of the biceps and semitendinosus and that of the semimembranosus near their origin; another is situated near the insertion of the biceps into the fibula, between the two parts of its tendon and the external lateral ligament of the knee, which occasionally becomes enlarged as the result of inflammation. The principal action of the biceps is to extend the hip and flex the knee. It also rotates the tibia outwards when the knee is semiflexed.

The *semitendinosus*, C, arises from an impression on the tuberosity of the ischium which it shares with the biceps, and in part from the tendon of the latter muscle. The upper tendon is broad and flat, and soon gives place to a thick muscular belly which gradually tapers downwards towards the lower tendon, which commences at the upper part of the popliteal space. This lower tendon is slender and rounded, and winds below the inner tuberosity of the tibia, to be inserted beneath the tendon of the sartorius, and below that of the

gracilis to the inner surface of the bone, internal to the tubercle. A fibrous expansion from the back of the tendon passes to the fascia of the leg. The semitendinosus is uncovered by muscle except above where it is beneath the gluteus maximus, and below where it lies under the expanded tendon of the sartorius. Its deep surface is in contact with the semimembranosus, the adductor magnus, and the internal lateral ligament of the knee. The outer border is in contact with the biceps almost as far as the popliteal space. The belly is intersected about midway by a delicate and glistening tendinous band which passes obliquely across the muscle downwards and outwards. The action of the muscle is to extend the hip and flex the knee, but it will also rotate the tibia inwards when the knee is semiflexed.

The *semimembranosus*, D, D, arises from the ischial tuberosity, from a special mark external and superior to that of the two muscles last described. The tendon, which is broad, and at the outer part extremely thin, gives place to a large muscular belly about the middle of the thigh, which passes down on the inner side of the popliteal space as far as the knee. The lower tendon is very strong and begins on the inner side of the fleshy belly about the middle of the thigh; it receives muscular fibres as far as the inner condyle of the femur, and then passes straight down behind the knee, to be inserted into an impression on the back of the inner tuberosity of the tibia; two strong expansions arise from the lower part of the tendon, one joins the posterior ligament of the knee, and the other is continuous with the fascia over the popliteus muscle. The semimembranosus lies beneath the semitendinosus and biceps and the gluteus maximus; its insertion is partly covered by the inner head of the gastrocnemius. The muscle rests upon the quadratus femoris, the adductor magnus, part of the inner head of the gastrocnemius, and the knee-joint. Its outer border corresponds to the biceps and the great sciatic nerve above, and

below to the popliteal vessels and the internal popliteal nerve. Its action is that of an extensor of the hip and a flexor of the knee; it may rotate the tibia inwards when the knee is semiflexed.

ARTERIES.

The cutaneous arteries in the middle line of the back of the thigh, consist of a series of anastomoses derived from the *sciatic, e*, one of the *perforating arteries, b*, and the *popliteal, l*; at the outer part are found branches from the *perforating arteries*, and at the inner side branches from the *profunda* and from the *femoral*.

NERVES.

The cutaneous nerves of the back of the thigh are principally derived from the *small sciatic, l*. The origin of this nerve from the sacral plexus has been before seen, and described at p. 234. After appearing from beneath the lower border of the gluteus maximus, the nerve runs almost vertically down the middle of the back of the thigh, at first in the hollow between the biceps and the semitendinosus, and then across the middle of the popliteal space. It pierces the deep fascia at the lower part of the popliteal space, or even further down the limb, and about the middle of the leg it ends by joining the external saphenous nerve (Plate 36, Fig 1). Near the lower border of the gluteus maximus there appear a number of large branches which are derived from the small sciatic at a higher level, some of which, 2, 2, 2, 2, wind round the lower border of the muscle to be distributed to the buttock, while others pass inwards to the perineum and the upper and inner part of the thigh; the largest of these, called the *inferior pudendal, 3*, reaches the scrotum, and joins the superficial perineal and inferior hæmorrhoidal branches of the internal pudic. In its course downwards the small sciatic gives numerous small branches, which pierce the deep fascia and pass inwards and outwards to supply the skin at the back of the thigh.

The *posterior branch of the internal cutaneous*, 7, is seen at the inner and lower part of the dissection.

FIG. 2.

The dissection for this drawing was prepared from that shown in Fig. 1, by making an incision in the *gluteus maximus* at right angles to the direction of its fibres, extending from about the middle of its lower border for three inches, and after turning the muscle up as far as possible, and cutting short the vessels and nerves upon its surface. The greater part of the long head of the *biceps*, the *semitendinosus* and *semimembranosus* were taken away, and the upper and lower attachments of these muscles were turned aside. The *adductor magnus* with the great sciatic nerve and the perforating arteries were then cleaned, while at the lower part of the preparation, the fat was taken from the popliteal space, exposing the popliteal vessels and nerves, the femur, a small piece of the back of the *vastus internus*, and the upper part of the *gastrocnemius*. The fascia was completely removed from the part of the *vastus externus* thus exposed; and, lastly, some of the fat of the ischio-rectal fossa was taken away, so as to show the edge of the sphincter ani and part of the erector penis.

MUSCLES.

This dissection shows the whole of the posterior surface of the *adductor magnus*, and the manner in which its fibres are pierced by branches of the profunda vessels. It also shows the position and arrangement of the *short head of the biceps*. It will be noticed that a small portion of the back of the *vastus internus*, N, is seen between the tendon of the *adductor magnus* and the femur, and also that on removing the *semimembranosus*, the *sartorius*, L, makes its appearance on both sides of the tendon of the *gracilis*.

ARTERIES.

The arteries seen consist principally of the *popliteal*, *a*, and some of its branches, which will be better described in connection with a later Plate ; and of those offsets from the perforating branches of the profunda, which pass to the hamstrings, and have been described at p. 311. The *transverse branch of the internal circumflex*, *m*, and twigs from the *inferior hæmorrhoidal*, *n*, are also seen at the upper part of the dissection.

VEINS.

The *popliteal vein*, *a*, almost covers the popliteal artery in this situation, and is itself in great part concealed by the internal popliteal nerve. It receives the short *saphenous vein*.

NERVES.

The *great sciatic nerve*, *l*, is the prolongation downwards of the strong nervous band formed by the union of the trunks which enter into the formation of the sacral plexus. After appearing, in the deep dissection of the buttock, from beneath the pyriformis, the nerve is continued downwards under cover of the gluteus maximus, the biceps and the edge of the semimembranosus. In this part of its course it rests upon the obturator internus and gemelli, the obturator externus, the quadratus femoris, the adductor magnus, and the lowest part of the origin of the short head of the biceps. At the lower third of the thigh, it divides into two branches, the internal popliteal, or popliteal proper, and the external popliteal, or peroneal. The point of division varies very much ; it may be actually in the popliteal space, or before the nerve leaves the pelvis. As the nerve descends, it supplies numerous muscular branches to the hamstrings and to the adductor magnus ; if the bifurcation take place low down it may supply one of the upper articular nerves to the knee-joint. The muscular branches are as follows :—*one for the long head of the*

biceps, 4, two for the *semitendinosus*, 7, 7, one entering above and one below the tendinous intersection, from one to three for the *semimembranosus*, 6, 6, 6, which enter the muscle in the lower third of the thigh; in common with the latter, one or it may be two branches to the *adductor magnus*, 8, 8, arise. All of these branches spring from the inner side of the great sciatic. From the outer side of the nerve, or in cases of high division, from the peroneal comes off the *nerve to the short head of the biceps*, 5, which enters its muscle on the outer side. The small *external articular nerve*, 11, comes either from the peroneal or from the outer part of the great sciatic, sometimes in common with the nerve to the short head of the biceps, and runs downwards beneath the tendon of this muscle, dividing into two branches which accompany the upper and lower external articular branches of the popliteal artery to the knee-joint.

Of the two trunks into which the great sciatic nerve divides the *internal popliteal*, 2, is much the larger, and continues the same course as the great sciatic itself, along the middle line of the limb; it soon disappears beneath the *gastrocnemius*, but continues as far as the lower border of the *popliteus* muscle, where it takes the name of posterior tibial. It gives off two or three *articular nerves to the knee-joint*, one of which, 12, is figured, *muscular branches* to the muscles of the calf and the *popliteus*, and a cutaneous branch, the *tibial communicating*, which, with a corresponding branch from the peroneal, forms the external saphenous nerve.

The *peroneal*, 3, or external popliteal (*see* Plate 36, Fig. 1, 2), follows the tendon of the biceps to the head of the fibula, and ends by piercing the upper part of the *peroneus longus*, and dividing into its terminal branches the anterior tibial, the musculo-cutaneous, and the recurrent articular. Besides the *external articular nerve*, it gives off small cutaneous twigs to the upper and outer part of the leg, and a larger one, the *fibular communicating* (Plate 36, Fig. 1, 4), which runs downwards and inwards to unite about the middle of the

back of the leg, or at a lower or a higher point with the tibial communicating, to form the external saphenous nerve.

Of the other nerves here seen no more need be said ; it will be noticed that a small piece of the *internal saphenous*, 13, was shown as it was passing downwards under cover of the *sartorius*.

The exact position of the great sciatic nerve is easily remembered ; it is important to bear it in mind for various reasons. Tenderness confined to the line it occupies, will sometimes serve to distinguish sciatica from other painful diseases of this region ; and for this disease, as for some other conditions, the surgeon may consider it necessary, to cut down upon the nerve in order to perform *nerve-stretching*. The best point to reach nerve is a little above the lower border of the *gluteus maximus* ; it is only necessary to expose the border of this muscle by cutting through the cutaneous structures, and to pull it upwards, when the nerve can be reached before it passes beneath the outer edge of the biceps. In this operation the small sciatic nerve must be avoided. The same incision would expose the small sciatic nerve if it were necessary to divide or remove a portion of it, as has been done in cases of painful neuromata, developed in connection with it or its branches. In dealing with sinuses connected with disease of the hip-joint, or of the innominate bone or femur, the knife may occasionally come into dangerous proximity with the great sciatic nerve ; the disastrous results of its injury are too obvious to require mentioning, but the surgeon must not forget the line of this important structure, if he be tempted, by the absence of large vessels, to choose the back of the thigh for his incisions, in cases where it may be needful from any cause to cut down upon the femur.

PLATE 36.

FIG. 1.

THIS dissection shows the position of the muscles at the back of the knee-joint, and the appearance of the popliteal space before these muscles are separated from one another. An incision was made at the back of the thigh at the junction of its lower and middle thirds, which half encircled the limb, and another parallel to it, and also half encircling the limb, a little below the middle of the calf. The ends of these were joined by vertical incisions, and the piece of skin so marked out was removed. After defining the subcutaneous vessels and nerves, the popliteal fascia was cleaned and removed without injuring them. As much fat was then taken from the popliteal space, as could be done without displacing the muscles surrounding it, or the vessels and nerves passing through it.

The *popliteal fascia* is that part of the deep fascia of the limb which covers in the popliteal space, and keeps the muscles which form the sides of the space in the relative position in which they are shown in the drawing. The fascia is strong in this position, and it passes round on the outer aspect of the limb to blend with the lower part of the ilio-tibial band, Fig. 3, †, and the capsule of the knee-joint, while on the inner side it passes round the muscles in this situation, and blends with the capsule of the joint, receiving slips from the *gracilis*, *sartorius*, and *semitendinosus*. The fascia is tight when the limb is extended, but becomes relaxed when the knee is flexed. It exerts an important influence upon the development and diagnosis of tumours in this region. For the diagnosis of swellings in the popliteal space, flexion of the knee is an obvious precaution, though this will not aid in the detection of an

abscess. The influence in modifying the direction of advance of an abscess or soft tumour is similar to that exerted by strong fasciæ elsewhere—*i.e.*, it will have a tendency to force them upwards into the thigh or downwards into the leg, instead of allowing them to make their way to the surface. The firm attachment of the fascia to the structures at the anterior part of the joint will prevent an abscess from burrowing in this direction.

The size of the *popliteal* space is not great before the muscles have been disturbed, though it is said to extend, in the dissected limb, from the level of the opening in the adductor magnus for the passage of the vessels, as far as the lower border of the popliteus muscle. It may be described as being diamond-shaped, the upper part of the diamond being, however, longer and more acute than the lower. The outer boundary is formed by the biceps above, and by the outer head of the gastrocnemius and the plantaris below, the inner boundary by the semitendinosus, the semimembranosus, the gracilis and sartorius above, and by the inner head of the gastrocnemius below. The floor of the space is formed by the back of the lower end of the femur, and the popliteus muscle covered by its fascia. Passing through this space are the main vessels of the limb, the artery lying deepest and supplying numerous articular, muscular, and cutaneous branches, the vein receiving the external saphenous vein. Superficial to the vessels, and like them, nearly in the middle line of the limb, is the popliteal nerve,¹ while the external popliteal or peroneal nerve,² follows the inner border of the tendon of the biceps. Several lymphatic glands lie along the course of the vessels, and all these structures are imbedded in a large quantity of loose fat. In making a diagnosis of a tumour in this situation, the surgeon will do well to consider the possibility of its having originated in any one of the structures occupying or forming the boundaries of the popliteal space, artery, bone, gland, &c., and he will not forget

the existence of the bursæ in connection with the insertion of muscles.* If that between the external lateral ligament and the tendon of the biceps be enlarged, the swelling is not likely to appear in the popliteal space; but if either of those in connection with the semimembranosus be filled with fluid, a roundish or egg-shaped tumour may result, occupying the inner side, but often extending to the middle of the space, frequently feeling very hard when the fascia is tightened over it, and if it reach as far as the artery, receiving from it a powerful heaving pulsation, which, however, is easily distinguished from the expansile pulsation of an aneurism. The frequent communication between one of the bursæ and the knee-joint, is a fact which must be borne in mind if any operative interference for the cure of such a condition be attempted. From that which has been said about a fourth bursa, it is clear that a similar tumour may in some cases be found on the outer side of the ham.

Ligature of the popliteal artery is an operation that is very seldom performed; it is one of extreme difficulty, and is liable to be followed by unpleasant consequences. If it be attempted, an incision, four or five inches in length, must be made at the back of the limb, beginning slightly to the inner side of the middle line, but terminating in the middle line below. The external saphenous vein is liable to be wounded in the first steps of the operation. When the popliteal nerve is reached, it, as well as the vein, is to be pulled to the outer side, and the artery is to be sought at a deeper level.

In performing *tenotomy upon the hamstrings*, the individual tendons are usually to be distinctly felt, and can be easily divided. No important structures are liable to injury upon the inner side, but the peroneal nerve may be cut in operating upon the tendon of the biceps. In order to avoid it, a blunt

* One is found between the inner head of the gastrocnemius and the semimembranosus, one between the semimembranosus and the tibia, another between the biceps and the external lateral ligament, and a fourth in some subjects between the outer head of the gastrocnemius and the biceps.

tenotome should be passed to the inner side of the tendon between the latter and the nerve.

FIG. 2.

This dissection was made by carrying a vertical incision along the middle line of the limb in front, extending from a point about six inches above the patella to one about three inches below that bone; another parallel to it, and of equal length, was made along the outer border of the popliteal space, and the upper and lower ends of these incisions were joined by transverse ones; the cutaneous structures were first dissected, and then the deep fascia was in great part removed.

The reader will notice the *prolongation of the fascia lata to the capsule of the knee*, *, and also *that derived from the aponeurosis of the vastus internus*, ☉; the capsule has been divided in front in order to show the *ligamentum patellæ*, †. It will also be observed that the tendons of the sartorius, gracilis, and semitendinosus are sending prolongations to the fascia of the leg.

FIG. 3.

The description of the method of preparing the last dissection will answer for this Figure, if the outer border of the popliteal space be substituted for the inner.

The cutaneous nerves on this side of the knee are not nearly so numerous as those upon the other; no doubt more might have been found by very careful dissection, derived from the external cutaneous and from the peroneal trunks. The lower part of the ilio-tibial band appears in this drawing. It will be remembered that the fascia lata at the outer part of the thigh is exceedingly strong throughout, and that such a strip as that here shown can only be obtained by artificial

separation. The fascia lata in this situation, like that upon the opposite side of the limb, blends with the capsule of the joint, as does part of the aponeurosis of the vastus externus. The capsule has again been opened in front in order to display the ligamentum patellæ. The *capsule of the knee* is a very indefinite term. It is generally applied to the posterior and internal ligaments of the knee, and that part of the fibrous investment of the joint which unites these structures and passes over the anterior and external ligaments. Considered in this way, it may be said that at each side the capsule is attached above to the femur and below to the tibia, near their cartilage-covered surfaces, and strengthened by strong bands of fibres derived partly from the fascia lata, partly from the aponeurosis of the vastus. Traced forwards, we find it fixed to the edges of the patella, and then passing over the surface of this bone and the ligamentum patellæ. Thus, in this situation if traced upwards, it is lost on the surface of the vastus; if traced downwards, it is seen to be attached to the tubercle of the tibia. If followed backwards, we find it blending at the inner side with the internal ligament, and on the outer side splitting into two parts, one of which passes over the long external ligament to blend with the fascia of the leg and the biceps tendon, while the deeper one blends with the short external ligament if this be present, and passes beneath the long one. Further back still, it consists of a thin fibrous layer beneath, but closely adherent to, the gastrocnemii, which unites at last with the sides of the posterior ligament.

The detailed account of the structures shown in this Plate will be found elsewhere.

PLATE 37.

FIG. 1.

THIS drawing exhibits the superficial dissection of the back of the leg. In order to prepare it, a transverse incision was carried across the back of the thigh, just above the condyles of the femur, which half encircled the limb; from the extremities of this, vertical incisions were made, which passed over the internal and external malleoli to the sides of the os calcis, and these latter were joined below by a second transverse cut over the most prominent part of the heel. After carefully dissecting the superficial vessels and nerves, the deep fascia was removed from the superficial muscles and the popliteal space; and some of the fat was taken away from this space without in any way disturbing the important vessels and nerves which it contains.

The *deep fascia* of the back of the leg is continuous above with that of the thigh, and at the outer side with that of the front of the leg. At the inner side, it is firmly attached to the internal border of the tibia. It consists of two parts, one which covers the superficial muscles, the other lying over the deeper ones. The former is not very thick, and blends on either side of the tendo Achillis with the deeper layer. This latter is thin where it intervenes between the soleus and the deep muscles, but thick on each side of the tendo Achillis. It not only covers the muscles, but also the posterior tibial vessels and nerves; it is attached above to the oblique line on the back of the tibia, and below to the os calcis and the malleoli. Between these bony points it joins, or may be said to form, the internal and external annular ligaments. Above, it receives prolongations from the tendons of the sartorius, the gracilis, the semitendinosus and the biceps.

The *internal annular ligament*, (Fig. 2, ¶) is a strong piece of the deep fascia of the leg which stretches between the internal malleolus and the os calcis. It protects the vessels and nerve which pass beneath it, and give origin by its lower border to the abductor pollicis. Beneath it are found the tendons of the three deep muscles of the back of the leg, surrounded by their own synovial sheaths.

MUSCLES.

The *gastrocnemius*, F, G, is the muscle which forms the most prominent part of the calf. It arises from the femur by two heads; the inner is attached to the back of the bone just above the outer condyle, and for a short distance to the line leading from this prominence to the linea aspera; the outer is fixed to the highest of the three marks on the outer side of the external condyle, and also to the upper and posterior part of this condyle. Both heads are firmly attached to the back of the capsule of the knee. They unite at the lower part of the popliteal space, of which they form the lower boundaries. The large bellies which result are partly tendinous, partly fleshy, and are separated by a deep furrow; they both are rounded below where they blend with the tendo Achillis about the middle of the leg, the inner extending somewhat lower than the outer. The muscle is subcutaneous, except above, where it is slightly overlapped by the inner and outer hamstrings, and is crossed by the peroneal nerve. It rests upon the plantaris, the popliteus, and the soleus, as well as the popliteal vessels, the internal popliteal nerve and the capsule of the knee. The action of the gastrocnemius is to flex the knee and extend the ankle.

ARTERIES.

The cutaneous arteries at the upper part of the back of the leg are derived from the popliteal and from the anastomotic; and, below, small twigs wind round the sides of the tendo

Achillis, which come from the posterior tibial, and from the peroneal.

VEINS.

The *short or external saphenous vein*, γ , originates from the outer part of the venous arch on the dorsum of the foot, which will be seen in Plate 38, Fig. 1. It winds behind the external malleolus, and passes up, at first along the outer side of the tendo Achillis, and then along the middle of the calf to reach the popliteal space. It perforates the deep fascia at a point which is liable to some variation, but is usually at the lower part of the ham, and it joins the popliteal vein near the upper part of this space. There are usually free communications between this and the internal saphenous, as well as with the deep veins at the back of the leg.

NERVES.

The trunk of the *internal saphenous*, 6, is seen as it passes from beneath the sartorius to the inner side of the leg; and one of its branches, 7, is shown winding to the back of the leg.

The *external saphenous*, 2, is a branch of the internal popliteal. It runs down the middle of the calf in the groove between the two bellies of the gastrocnemius, in company with the external saphenous vein. Keeping close to this vein, it passes along the outer edge of the tendo Achillis to the external malleolus, behind which it passes to supply the outer side of the foot and little toe. It is joined usually by the small sciatic, 8, and by a smaller or larger piece of the following nerve. In the present instance, the communication only took place by means of a very small twig indeed.

The *fibular communicating, or ramus communicans fibularis*, 5, is a branch of the external popliteal. It passes down along the outer side of the calf, and supplies numerous cutaneous branches in this situation; it usually but not always, joins the external saphenous.

FIG. 2.

In order to make this dissection, the skin was removed for about an inch higher up the limb than in the last preparation. Portions of the *semimembranosus*, *semitendinosus* and *biceps* were taken away, and the two heads of the *gastrocnemius* were divided near their origin, the muscle being afterwards removed by cutting through the upper part of its tendon above its union with that of the *soleus*. During this process, the vessels and nerves entering the *gastrocnemius*, as well as the superficial structures, were necessarily divided. The parts thus laid bare were then cleaned, and lastly the fascia was removed from the interval between the *tendo Achillis* and the tibia, so as to define the internal annular ligament and the muscles, vessels and nerves which the fascia covers in this situation.

MUSCLES.

The insertion of the *semimembranosus*, A, is now shown, as well as the prolongations from it to the posterior ligament of the knee, and the *popliteus fascia*; the latter has been in part removed.

The *soleus*, K, arises from the back of the head of the fibula, and from the upper third or more of its posterior surface, from the oblique line on the tibia and the internal border of this bone in the middle third of its length. Between the two bones it is attached to a tendinous arch, which crosses the commencement of the posterior tibial vessels and nerve; but this is only the upper edge of the strong aponeurosis on the deep surface of the muscle, from which a prolongation is also sent to the fascia of the *popliteus*. The surface of the *soleus* is more or less tendinous on both aspects, but the aponeurosis on the anterior surface, which has been referred to already, is much more distinct above, while that on the posterior surface is best seen below.

At the lower end this posterior tendon becomes narrower and whiter, and a little below the middle of the leg it blends with that of the gastrocnemius to form the tendo Achillis; but the muscular fibres on the anterior aspect reach down to within two inches of the os calcis. The soleus forms the projection of the lower part of the calf. It is partly covered by the gastrocnemius, partly subcutaneous; it rests on the deep muscles and the posterior tibial vessels and nerves. It acts as an extensor of the ankle.

The *tendo Achillis* is a broad, flat tendon above, becoming gradually rounder below till it reaches its narrowest point nearly opposite the internal malleolus, after which it again becomes somewhat wider, and is attached to the lower part of the posterior surface of the os calcis, a small bursa being situated between the upper part of this surface and the tendon. The tendo Achillis *may be ruptured* during sudden contractions of the muscles of the calf. In treating such an accident, it is essential to keep the knee flexed and the ankle extended, in order to avoid as much as possible the separation of the two ends. It is often necessary to *divide the tendon* in cases where it is unnaturally tense, either from *talipes equinus*, or from some other cause. In performing the operation, the surgeon will find it a convenient plan to pass the tenotome between the skin and the tendon, and to cut forwards; the risk of wounding the vessels is *nil*, and the danger of the knife slipping out through the skin is avoided, an accident which has occasionally happened when the other plan, of cutting from within outwards, has been adopted.

The *plantaris*, H, has a small muscular belly and a remarkably long tendon. It arises from the back of the femur above the external cartilage, and from the back of the capsule of the knee, but sometimes only from the latter. At its origin it is closely connected with the outer head of the gastrocnemius, and indeed it looks very much as if it were a part of this muscle. The tendon, after crossing the popliteal vessels and nerve, and

being itself crossed by numerous branches from these trunks, lies between the soleus and the gastrocnemius, and becomes superficial at the inner side of the tendo Achillis, alongside of which it passes down to be inserted either into the side of this tendon close to its termination, or separately into the os calcis. The action of the muscle resembles that of the gastrocnemius. The tendon, if stretched sideways, may be made to assume the appearance of a delicate and glistening riband of considerable width. If ruptured, as occasionally happens from sudden strains, most unpleasant symptoms result, consisting of great pain on movement of the limb, accompanied by considerable extravasation of blood.

ARTERIES.

The *popliteal, a*, extends from the opening in the adductor magnus to the lower border of the popliteus muscle; it enters the popliteal space somewhat to the inner side of the limb and ends almost in the middle line. The vessel rests upon the femur, the posterior ligament of the knee and the fascia over the popliteus. It is covered by the semimembranosus at its commencement, and by the gastrocnemius and plantaris near its termination; the popliteal vein and nerve are somewhat external to it above, but below they lie completely over it. A small twig of the obturator nerve destined for the knee-joint often lies on it at the upper part of the ham.

The branches of the artery are cutaneous, muscular, and articular. The *cutaneous* branches are distributed over the ham and the back of the leg. The *muscular* may be divided into two sets, an upper which pass into the hamstrings, and a lower and larger series called *sural*, which have been partly divided in this dissection, and are distributed to the muscles of the calf. The *articular* branches are five in number. The two *upper, b* and *c*, pass inwards and outwards above their respective condyles, beneath the corresponding hamstrings. The two *lower* are arranged as follows:—

the *inner*, *d*, passes below the inner tuberosity of the tibia, beneath a prolongation of the internal lateral ligament of the knee (Fig. 3, +.); the *outer*, *e*, is situated above the head of the fibula, and passes beneath the external lateral ligament (Fig. 3, ×.). The *azygos* branch is not shown, it runs straight forward and pierces the posterior ligament of the knee. These arteries enter into a free anastomosis with one another and with the other vessels supplying the knee-joint—viz., the anastomotic, the external circumflex, and the recurrent articular. All the articular branches of the popliteal, with the exception of the last, supply cutaneous, and some of them muscular branches as well.

Not only is the popliteal artery almost constantly subjected to alternating flexion and extension, but during the movements of the knee it occasionally meets with violent strains or wrenches. It is thus not surprising that, if the vessel be atheromatous, it is more liable than almost any other artery to become the seat of an aneurism. The anatomical relations indicate several points which bear upon the treatment of this disease. It is well adapted for the application of the treatment by flexion, for if the joint be completely bent, and an aneurism be present, the posterior tibial pulse often becomes completely imperceptible. From its close relations to the popliteal vein and nerve, any direct operation upon the aneurism itself is necessarily accompanied with considerable risk, and should not be attempted except under very exceptional circumstances. Lastly, it is peculiarly favourably situated for a cure by means of the Hunterian operation—viz., the application of a ligature to some part of the femoral trunk.

VEINS.

The *popliteal vein*, *a*, lies at first superficial to the artery, but at the upper part of the ham it is to the outer side of this vessel; it receives the external *saphenous vein*, *β*, and other tributaries corresponding to the branches of the artery.

NERVES.

The two *popliteal nerves* are described at p. 321 ; the muscular branches of the internal popliteal and the external articular nerves are now well seen.

FIG. 3.

This dissection was made from that shown in the last Figure by removing the plantaris, and by detaching the soleus from its bony attachment, and cutting through the tendo Achillis at the lower end. The fascia and areolar tissue were then removed from the structures so exposed and from the peronei.

MUSCLES.

The *popliteus*, K, is now completely exposed with the exception of the tendon of origin. It arises from the lowest of the three marks upon the outer surface of the external condyle of the femur. The tendon passes backwards beneath the external lateral ligaments of the knee, in close contact with the external semilunar cartilage to which it is attached ; it perforates the posterior ligament at the outer part, and receives some fibres of origin from it in doing so. The tendon then gives place to a flat muscular belly, which is directed downwards and inwards, and is inserted on that part of the posterior surface of the tibia which is situated above the oblique line. The muscle is covered by a strong fascia which is derived from the tendon of the semimembranosus ; it is covered by the gastrocnemius and the plantaris, and is crossed by the popliteal vessels and nerve. It rests upon the back of the knee-joint and the tibia. Its action is to rotate the tibia inwards, and to flex the knee.

Of the remaining deep muscles, two are now well seen ; the tibialis posticus, N, O, is almost completely covered by the other two muscles, and by the vessels and nerves.

The *flexor longus digitorum*, L, arises from the inner half of the posterior surface of the tibia, beginning at the oblique line, and passing down to within three inches of the lower end of the bone. It also takes origin from the strong fascia covering the tibialis posticus. The tendon commences near the top of the muscle, but fleshy fibres are attached to it as far as the ankle-joint; it then lies on the back of the tibia external, to the tendon of the tibialis posticus, and close to the inner side of the posterior tibial vessels. It passes beneath the annular ligament into the sole of the foot, where it will be seen (Plate 40), to divide into four tendons, which are inserted into the terminal phalanges of the four outer toes. The muscle is in part covered by the soleus and the posterior tibial vessels and nerve; in part it is subcutaneous. It rests upon the tibia, and upon the tibialis posticus, the tendon of which muscle appears from beneath it near the ankle. The action is to bend the interphalangeal and metatarso-phalangeal joints of the four outer toes, and afterwards to extend the ankle.

The *flexor longus pollicis*, M, arises from the lower half or two-thirds of the posterior surface of the fibula, below the origin of the soleus. It also arises from the fibrous septum separating it from the peronei, and from the back of the fascia over the tibialis posticus. As in the case of the last muscle, the tendon begins near the upper end, and receives fleshy fibres as far as the ankle-joint. After passing behind the lower end of the tibia, where it is lodged in a groove external to the position of the posterior tibial nerve, it enters another groove at the back of the astragalus, and thus reaches the sole of the foot, where it will be seen (Plate 40), passing forwards to be inserted into the terminal phalanx of the great toe. The muscle is almost completely covered by the soleus, but close to the ankle it lies slightly internal to the tendo Achillis; it rests upon the fibula and the tibialis posticus; the peroneal artery runs through the fibres of the muscle. Its action is to flex the great toe, and to extend the ankle.

The *peroneus longus*, M, is now pretty fully exposed, and the *peroneus brevis*, Q, appears behind the lower part of its tendon. These muscles will be described in connection with the front of the leg.

ARTERIES.

The popliteal divides at the lower border of the popliteus muscle into the posterior and the anterior tibial. The *anterior tibial*, *f*, is just visible as it is passing over the interosseous membrane to the front of the leg, where it will be met with later on (Plate 390).

The *posterior tibial*, *g*, beginning at the lower border of the popliteus, passes down the back of the leg with an inclination to the inner side, and ends at the lower border of the internal annular ligament about an inch below and slightly behind the tip of the internal malleolus. In its upper half it rests upon the tibialis posticus and is covered by the soleus; in its lower half it is subcutaneous, and rests on the flexor longus digitorum, the tibia and the ankle-joint. A vena comes lies on each side of it; the posterior tibial nerve, which is at first superficial to it, soon reaches the outer side, and maintains this position to the end. It supplies numerous cutaneous and muscular offsets, a nutrient vessel to the tibia which perforates the tibialis and enters the bone at a point which is subject to some variation, articular branches to the ankle, the peroneal and a communicating branch uniting it with the peroneal.

Of the *cutaneous* branches, the calcaneal (*see* Plate 38, Fig. 2) is the most important.

The *muscular* branches enter the deep muscles and the soleus; one of these to the latter muscle ascends to the knee-joint (Ellis).

The *communicating branch* passes transversely outwards beneath the flexor longus pollicis to join a corresponding branch from the peroneal. Other communicating branches between these two vessels are found lower down.

The *peroneal*, *h*, leaves the posterior tibial about an inch and a half from its commencement, and passes outwards and downwards, in the fibres of the flexor longus pollicis, towards the external malleolus, where it ends by dividing into two branches, one of which continues the course of the vessel itself behind the malleolus (*see* Plate 38, Fig. 3), while the other, the *anterior peroneal*, passes forwards below the interosseous membrane, to end on the front of the ankle in an anastomosis with the other vessels in this situation. The peroneal supplies *cutaneous* and *muscular* offsets, a *nutrient branch* to the fibula, and a *communicating branch* to join that from the posterior tibial mentioned above. It frequently happens that the peroneal is large, and gives off some of the branches usually derived either from the anterior or the posterior tibial; or it may be that it is small, and some of its branches are supplied from one of these vessels.

If it be required to *ligature the posterior tibial artery* at the ankle, a curved incision is made about midway between the internal malleolus and the most prominent part of the heel, or parallel with the inner border of the tibia and midway between this and the tendo Achillis. The dissection is carried through the skin and subcutaneous tissue and the annular ligament or deep fascia, as the case may be, and the artery is separated from the veins which lie on either side of it. To tie it in its upper third, an incision must be made parallel to, and half an inch behind, the inner border of the tibia, three or four inches in length; after cutting through the skin and superficial and deep fasciæ, and pulling the gastrocnemius backwards, and the internal saphenous vein (if this be exposed) forwards, the fibres of the soleus are divided until the tendon upon its deep surface appears. An incision is then made through this tendon, and on raising it, the artery is easily reached by dividing the layer of the deep fascia by which it is covered.

A somewhat similar operation will enable the surgeon to

ligature the peroneal artery in those very rare instances in which it may be deemed advisable to tie it. The incision should be about three inches long, parallel to and just behind the fibula opposite the middle of this bone. The fibres of the soleus are divided, and the flexor longus pollicis will come into view. Malgaigne recommends that the attachment of this muscle to the fibula should be divided, and the artery sought beneath it, and he points out that the muscle is aponeurotic at its deep surface, and that the vessel lies beneath, not upon, this aponeurosis.

VEINS.

Venæ comites accompany both the posterior tibial and peroneal arteries, which unite with those surrounding the anterior tibial to form the popliteal vein.

NERVES.

The *nerve to the popliteus*, 3, is now seen winding round the lower border of the muscle it supplies.

The *posterior tibial*, 4, is the continuation of the popliteal nerve. It lies at first superficial to the artery of the same name, but soon passes to its outer side, and continues to occupy this situation as far as its termination, which takes place at the lower border of the annular ligament, or at a somewhat higher point. The nerve *gives muscular branches to the deep muscles*, and usually one *to the soleus*. Near the lower end a large *cutaneous offset*, 8, leaves the nerve, and after perforating the internal annular ligament is distributed to the posterior part of the sole. It usually consists of two parts, as shown in the drawing.

PLATE 38.

FIG. 1.

THIS dissection is simply intended to show the *tibialis posticus*. It was made from that shown in Plate 37, Fig. 3, by removing the flexor longus digitorum and the flexor longus pollicis, dissecting the peroneal artery from the fibres of the latter muscle, and taking away the fascia over the *tibialis posticus*.

MUSCLES.

The *tibialis posticus*, B, arises from the outer part of the posterior surface of the tibia below the obliqueline, its origin extending somewhat lower than that of the flexor longus digitorum, and from that part of the fibula which intervenes between the interosseous and the oblique lines, and which is sometimes called the internal, sometimes the posterior part of the internal, surface. It also arises from the fascia which separates it from the contiguous muscles and from the interosseous membrane. It rests on the bones of the leg and the interosseous membrane, and is covered by the long flexors of the toes and the posterior tibial vessels and nerves. Its tendon begins near the upper part of the muscle. It becomes superficial at the inner side of the tendon of the flexor longus digitorum and occupies a groove at the back of the internal malleolus, whence it passes along the inner side of the foot (Fig. 2, B) to be inserted, primarily into the tubercle of the scaphoid, but also by various prolongations which are seen in the sole of the foot, to others of the tarsal and to some of the metatarsal bones. Between the two bony origins of the muscle, the anterior tibial vessels pass forwards. Its action is to extend the ankle and to adduct and invert the foot.

In cases of *talipes varus* the tendon of the *tibialis posticus*

sometimes requires division. This may be done either above or below the annular ligament. No very special instructions are needed for the latter operation. For the former, the tendon is made tight by an assistant, and the limb is turned so that the inner surface is uppermost. If the tendon can be felt, a sharp tenotome is inserted between it and the tibia at a distance of about one and a half inch above the malleolus, the knife being held perpendicular to the limb (which is supposed to be lying on its outer side). If neither the inner border of the bone nor the tendon can be felt, a point midway between the anterior and posterior borders of the limb will indicate pretty accurately the desired spot. After the puncture has been made with a sharp knife, this is withdrawn and a blunt one inserted (with the view of avoiding the vessels), and the tendon is divided by cutting outwards.

This drawing shows the peroneal artery, and also the nerves entering the tibialis posticus.

FIG. 2.

This dissection illustrates the arrangement of the structures upon the inner side of the ankle and foot. A transverse incision was made at the inner aspect of the limb from the front of the internal malleolus to the middle line behind. From the posterior end of this a cut was made along the tendo Achillis to the lowest point of the heel, and thence continued along the inner border of the foot to the ball of the great toe. The ends of these two incisions were joined by a third passing over the inner part of the dorsum of the foot. After dissecting the cutaneous structures, as much of the deep fascia of the leg as was exposed, and a part of the internal annular ligament were taken away, and the subjacent parts were defined. Lastly, the abductor pollicis was exposed by removing the inner part of the plantar fascia, and the tendon of the tibialis anticus was cleaned.

It will not be necessary to dwell upon the anatomy of any of the structures here shown, as they are all described elsewhere; but it may be pointed out that the calcaneal branches of the posterior tibial artery and nerve are well seen, together with part of the arterial anastomosis on the heel, to which reference is made below.

FIG. 3.

This dissection shows the mutual relations of the parts at the outer side of the foot and ankle. A transverse cut was made four inches above the external malleolus from the anterior to the posterior border of the limb. From the anterior extremity of this another was taken to the interval between the two inner toes, and from the posterior end a third to the back of the heel, and this was prolonged along the outer border of the foot. The two last incisions were then joined by a fourth across the metatarso-phalangeal joints. The deep fascia was in part removed, as shown in the drawing, and the structures exposed in this way were carefully cleaned.

As in the case of the last Figure, scarcely any description will be given to this dissection, and for the same reasons.

The reader will notice the terminal branch of the *peroneal artery*, *a*, passing down behind the external malleolus; the *anterior peroneal*, *b*, in front of the malleolus; and a branch of the *external plantar*, *c*, running backwards to anastomose with the other two, this latter having been no doubt reinforced by the external malleolar or some other branch of the anterior tibial. Looking back to Figure 2, he will see the *calcaneal branch of the posterior tibial*, Fig. 2, *b*, joined by twigs from the *internal malleolar* and the *internal plantar*, and he will understand how all these vessels unite in one free anastomosis over the heel. This anastomosis is of interest to the surgeon in connection with *Syme's amputation* at the ankle; the vessels lie close to the bone, and unless they are preserved by keeping the

knife turned towards the bone during the reflection of the heel flap, the vitality of the latter is much endangered. It is supposed that the calcaneal artery is not liable to be injured if the knife be entered on the inner side (according to Mr. Syme's instructions), at a point exactly opposite the tip of the external malleolus; but this supposition appears to be open to some doubt on account of the fact that the seat of origin of this vessel from the posterior tibial artery is liable to considerable variation; this does not, however, seem to be a point of much moment when the great freedom of the anastomosis is borne in mind.

PLATE 39.

FIG. 1.

THIS dissection gives a superficial view of the structures which occupy the front of the leg. In order to make it, an incision was carried across the front of the knee from side to side of the limb, opposite the middle of the patella. From the inner end of this a vertical cut was made over the inner border of the tibia, and prolonged along the inner border of the foot to the inner side of the great toe. On the outer side a similar cut was made along the most prominent part of the swell formed by the peronei muscles, to the external malleolus, whence it was prolonged along the outer border of the foot to the outer side of the little toe. The skin included by these incisions was removed, and at the same time was taken away from the toes by means of small incisions along the sides and across the end of the dorsal surface of each. The cutaneous structures were first dissected, and their position accurately noted on a preliminary sketch; the deep fascia was then laid bare and removed, with the exception of that part of it which forms the anterior and external annular ligaments of the ankle. Lastly, the structures thus exposed were carefully cleaned.

The whole of the internal surface of the tibia, extending from the internal malleolus to the inner tuberosity, is thus laid bare, whereas the fibula is completely surrounded by muscles, except at the upper and lower ends. This difference between the relations of the two bones makes the difficulty of diagnosing a fracture much greater in the one case than in the other; a fracture of the tibia being one of the

most obvious of surgical injuries, while one through the middle of the fibula is often very difficult to discover.

The deep fascia of the front of the leg is throughout thick, and of a glistening white colour. It is firmly attached to the crest of the tibia and to the upper and lower ends of the fibula, as well as to the front of the latter bone by means of a strong intermuscular septum which passes back between the peronei and the muscles on the front of the leg. A similar but much less definite septum is found between the upper ends of the tibialis anticus and the extensor longus digitorum. Opposite the ankle this fascia is strengthened by bundles of transverse and oblique fibres, forming what is known as the *anterior annular ligament* of the ankle. This may generally be found naturally separated into the two portions, *upper*, *, and *lower*, †, shown in the Plate; it can always be made artificially to assume this appearance; but the interval between the two portions is sometimes almost as strong as the bands above and below it. The upper part extends transversely from the tibia to the fibula, just above the ankle-joint, and it has beneath it one synovial sheath for the tendon of the tibialis anticus to glide in; the other muscles are not at this point supplied with such investments. The lower part of the ligament is shown in Plate 38, Fig. 3, as well as here; in the former case rather more of the fascia has been removed, so that the condition approximates more nearly to the description about to be given.* It may be looked upon as being V-shaped, the single attachment being external, and the double attachment internal. Externally, it is fixed by two strong pieces (Fig. 2, †) to the upper surface of the os calcis behind the origin of the extensor brevis digitorum. The fibres pass inwards and upwards across the foot, and then

* If the lower part of the anterior ligament is considered to be attached to the external malleolus, as in this drawing, the appearance of two bands crossing one another like the parts of a letter X is given to it; hence the name of *ligamentum cruciatum* sometimes applied to it.

divide into two portions, one of which ascends to the internal malleolus, whilst the other passes downwards to the inner row of carpal bones. Beneath it are three separate sheaths, one for the extensor longus digitorum and peroneus tertius, another for the extensor proprius pollicis, and a third for the tibialis anticus. The function of the ligament is to hold down the tendons in position, and to prevent their becoming unduly prominent during extension of the toes or flexion of the ankle.

In the description of the deep fascia of the leg we must include the *external annular ligament*, the arrangement of which will be gathered by referring to Plate 38, Fig. 3. It consists of fibres passing from the external malleolus to the outer side of the os calcis, and it is intimately connected with the sheath of the peronei (Plate 38, Fig. 3, +). Beneath the external annular ligament there is but one synovial sheath, which sends prolongations into the two compartments of the special sheath of the peronei.

Bands of fascia are found over the metatarso-phalangeal joints, binding down the tendons in their positions; one of them has been left in the dissection over the fourth toe.

MUSCLES.

The *tibialis anticus*, A, arises from the outer side of the external tuberosity, and from about half the outer surface of the tibia; from that part of the anterior surface of the interosseous membrane which is contiguous to its tibial origin, from the fascia of the leg and from the septum between it and the extensor longus digitorum. The muscular belly gives place, in the lower third of the leg, to a strong tendon, which passes over the front of the tibia and the inner side of the tarsus (Plate 38, Fig. 2, A), to be inserted into the internal cuneiform bone and the base of the first metatarsal. A small bursa intervenes between its insertion and the base of the internal

cuneiform, which the surgeon will occasionally find distended with fluid. The muscle is subcutaneous. To its outer side are the extensor longus digitorum and the extensor proprius pollicis, as well as the anterior tibial vessels and nerves. Its action is to flex the ankle and to adduct and invert the foot.

The tendon of the tibialis sometimes requires division in cases of talipes varus. The operation may be performed at the ankle or at the insertion of the muscle.

The *extensor longus digitorum*, B, arises from the external tuberosity of the tibia, and from the outer part of the anterior surface* of the fibula, for about three-quarters of its length; for a short distance (about an inch) from the interosseous membrane, from the fascia of the leg, and from the septa dividing it from the tibialis anticus and from the peroneus longus. The tendon appears at the anterior border of the muscle about its middle, and after traversing both divisions of the anterior annular ligament, divides into four parts which pass forwards to the four outer toes. Each tendon spreads out into a thin aponeurosis over the back of the first phalanx of the toe, and this aponeurosis is joined by slips from the short extensor, the lumbricalis and the interossei; it then splits into three portions: the central one is inserted into the upper surface of the base of the second phalanx, while the lateral pieces blend together and are inserted on the upper and posterior part of the terminal phalanx. The belly of the muscle is more or less intimately united with that of the peroneus tertius; it is in relation, on the outer side with the peroneus longus and peroneus brevis, on the inner side with the tibialis anticus and the extensor proprius pollicis, and the anterior tibial vessels and nerves. The tendon crosses the extensor brevis digitorum, and, like the anterior surface of the muscle itself, is subcutaneous. The muscle acts as an extensor of the outer toes, drawing them at

* Sometimes called the anterior part of the inner surface.

the same time slightly outwards;* it flexes the ankle, imparting to the foot a certain amount of abduction and rotation outwards.

The *peroneus tertius*, C, has been looked upon as a part of the last muscle, but the division between the two is more readily accomplished than is generally supposed. It arises from the lower fourth of the anterior surface of the fibula, from the contiguous part of the interosseous membrane, and from the septum between it and the *peroneus brevis*. The tendon passes through the same compartment, in the lower part of the anterior annular ligament, as that of the *extensor longus digitorum*, and is inserted into the upper surface of the fifth metatarsal bone, near the posterior end. It often sends a slip to the upper surface of the fourth metatarsal (described by Sappey as normal), which is figured in Plate 38, Fig. 2. The muscle is in relation internally with the *extensor proprius pollicis*, externally with the *peroneus brevis*; it is subcutaneous, and rests on the *extensor brevis digitorum*. It flexes the ankle, it abducts the foot and everts it slightly.

The *extensor proprius pollicis*, F, arises from the second and third quarters of the anterior surface of the fibula and from part of the interosseous membrane, the origin being wholly from bone above, and from membrane below. The tendon appears on the anterior surface of the muscle, passes through a separate sheath in the lower part of the annular ligament, and is inserted into the dorsal surface of the terminal phalanx of the great toe. A second small slip (present in this case, but not represented) is often attached to the first phalanx (the *extensor primi internodii hallucis longus*). The muscle lies, at first, between the *tibialis anticus* and the *extensor longus digitorum*, having the anterior tibial vessels and nerves to the inner side. It becomes superficial in the lower third of the

* The action upon the toes will be again referred to in connection with the description of the *extensor communis digitorum manus*.

leg, and continues so to the end. It crosses the vessels and nerves in front of the ankle, and then rests on the inner row of tarsal bones. It is an extensor of the great toe, and a flexor of the ankle; it is also a weak inverter of the foot.

The *extensor brevis digitorum*, G, arises from the upper surface of the calcaneum, external to the attachment of the interosseous ligament, and in front of that of the anterior annular ligament. It forms a broad fleshy belly on the dorsum of the foot, which ends in four tendons that pass to the outer side of the four inner toes. The slip to the great toe is more or less distinct at its origin from the rest of the muscle, and is inserted on the upper surface of the base of the first phalanx, Fig. 2; for which reason it is sometimes called the *extensor brevis hallucis*. The other tendons blend with the expansion formed by the extensor longus upon the back of the first phalanges of the toes. The muscle rests upon the tarsus, and is crossed by the tendons of the extensor longus; the inner tendon crosses the dorsal artery of the foot. The muscle extends the toes, and is supposed to counteract the tendency of the long extensor to abduct them.

It is important to remember the existence of this small muscular belly, in examining the dorsum of the foot for a supposed collection of fluid; a perfect sense of fluctuation is, of course, obtained by feeling transversely to the fibres of the muscle; and may, if the foot be swollen, say from gout, lead to an unpleasant mistake, unless care be taken.

The *peroneus longus*, D, arises slightly from the external tuberosity of the tibia, external to the origin of the extensor longus digitorum, from the head and upper two-thirds of the outer surface of the fibula, from the fascia of the leg, and from the septa between it and the contiguous muscles. The origin from the fibula does not occupy the whole width of the anterior surface, which is partly devoted to the peroneus brevis; nor is it quite continuous throughout, for at the part

where the peroneal nerve and the branches into which it divides are situated, the muscle is attached to a fibrous arch which bridges over them. The tendon appears on the outer side of the muscle about the middle of the leg, and passes down behind the external malleolus, being contained at first in a sheath common to it and the extensor brevis beneath the external annular ligament, and afterwards in a separate sheath of its own as it passes obliquely across the sole of the foot (where it will be again seen), to be inserted into the first metatarsal and the internal cuneiform bones. The muscle rests upon the fibula and the peroneus brevis, and is subcutaneous except in the sole of the foot. The extensor longus digitorum is in contact with its anterior border above, and the soleus and the flexor longus pollicis with its posterior border. The muscle acts as an extensor of the ankle, and an abductor and everter of the foot.

The *peroneus brevis*, E, arises from the lower two-thirds of the outer surface of the fibula, the origin extending up in front of that of the peroneus longus. It also takes origin from the fascia of the limb and the intermuscular septa. The tendon appears on the outer surface of the muscle above the middle; it becomes free from fleshy fibres at the lower part of the external malleolus, and winding behind this bone, at first in the sheath common to it and the peroneus longus beneath the external annular ligament, and afterwards in its own special sheath, it is inserted into the tuberosity at the base of the fifth metatarsal bone. It very often sends forward a delicate tendinous prolongation to be attached to the upper and back part of the first phalanx of the little toe. The muscle is in great part covered by the peroneus longus, but in front and behind the tendon of this muscle it is superficial, reaching forwards to touch the peroneus tertius, and backwards to the flexor longus pollicis. The muscle is an abductor and everter of the foot, and is generally considered to be an extensor of the ankle.

ARTERIES.

The cutaneous arteries on the front of the leg are derived principally from the anterior tibial; but at the upper part some twigs are found from the articular branches of the popliteal and from the anastomotic of the femoral, and at the lower part of the leg from the peroneal.

VEINS.

On the dorsum of the foot is an arch of superficial veins, the convexity of which looks towards the toes. This ends at the inner side of the limb in the *internal saphenous*, β , and at the outer side in the *external saphenous*, α .

NERVES.

The superficial nerves of the front of the leg are derived at the inner side from the *internal saphenous*, 1, and its *patellar branch*, 2; at the outer side are some small twigs of the *external popliteal* and of the *external saphenous*, 4, and the latter nerve supplies the digital branch to the outer side of the little toe. The *musculo-cutaneous*, 3, supplies the centre of the limb, and is joined to both the saphenous nerves. It will be described in connection with Fig. 2. The termination of the *anterior tibial*, 5, is cutaneous between the first two toes.

FIG. 2.

This dissection was made from that shown in Fig. 1, by taking away the anterior annular ligament and most of the superficial vessels, and all the superficial nerves except the terminal branch of the anterior tibial. The extensor longus digitorum and the extensor proprius pollicis were removed with the exception of their tendons of insertion. The tendons of the extensor brevis digitorum were cut, but the origin was only partially removed and reflected. The vessels and nerves were then cleaned, and in order to show them completely, the upper parts of the tibialis anticus and of the peroneus longus

were turned down. Lastly, the metatarsal bone of the great toe was taken out, in order to show that part of dorsal artery of the foot which is distributed in the sole of the foot.

ARTERIES.

The *anterior tibial, a*, enters this region by passing between the two points of the bifid upper extremity of the tibialis posterior, and then over the upper border of the interosseous membrane. It runs down the front of the leg as far as the middle of the ankle-joint, where it takes the name of dorsal artery of the foot. Its line on the surface of the limb is one drawn from the inner side of the head of the fibula to the middle of the ankle-joint. The vessel rests on the interosseous membrane and the lower end of the tibia, and is overlapped by the muscles between which it lies. Thus, the tibialis anticus is in contact with it internally for almost the whole of its extent; while the extensor longus digitorum touches it externally above, and the extensor proprius pollicis below; but the latter muscle crosses over to the inner side of the artery just above the ankle. It is surrounded by venæ comites. The anterior tibial nerve reaches its outer side about the middle of the leg, and crosses it once or twice, but lies to the outer side of the vessel at its termination. The artery gives numerous muscular and cutaneous offsets, and the following named branches. The *recurrent articular, f*, runs upwards and inwards in the fibres of the tibialis anticus with the nerve of the same name, and supplies cutaneous and muscular branches, as well as twigs to the joint which anastomose with the other arteries in this situation. The *internal malleolar, d*, a branch of variable size, runs inwards over the internal malleolus, supplying cutaneous and articular offsets. The *external malleolar, e*, usually larger in size, leaves the anterior tibial either opposite the internal malleolar, or at a somewhat higher level. It passes either transversely outwards, or obliquely outwards and downwards, has a free inosculation with the anterior peroneal, *n*, and running

down in front of the external malleolus, joins in the anastomosis about the heel, described at p. 342.

Ligature of the anterior tibial is practised either in the upper or lower third. In the former case, the line of the vessel having been determined, an incision of about three inches is made; the surgeon then searches for the interval between the tibialis anticus and the extensor longus digitorum, which, it must be remembered, is not marked by such a distinct intermuscular septum as that between the extensor and the peroneus longus; and on separating the muscles he finds the artery resting on the interosseous membrane. In the lower third, exactly similar directions will guide to the artery, the extensor proprius pollicis being substituted for the extensor longus digitorum.

The *dorsal artery of the foot, g*, is the continuation of the anterior tibial; it extends on the front of the foot from the middle of the ankle to the back of the first interosseous space. It rests on the astragalus, the scaphoid, and the inner two cuneiform bones, and is crossed by the innermost tendon of the extensor brevis digitorum. This latter tendon and that of the extensor proprius pollicis lie to its inner side, the innermost tendon of the extensor longus digitorum is to the outer side. Venæ comites surround the artery; the nerve is usually to the outer side, but this arrangement is not constant, as is exemplified by this drawing. After reaching the first interosseous space the artery passes into the sole of the foot, where it supplies digital branches to the two inner toes, and inosculates with the external plantar. The dorsal artery of the foot supplies branches on the inner side, distributed to the skin and the articulations, as well as to the muscles of the great toe. These anastomose freely with the arteries at the inner side of the foot, as shown in Plate 38, Fig. 2. From the outer side it gives off the following two named branches. The *tarsal branch, h*, passes forwards and outwards beneath the extensor brevis digitorum, and anastomoses with branches

of the external plantar at the outer border of the foot. It supplies the muscles, integuments, and joints. The *metatarsal branch, k*, runs outwards on the bases of metatarsal bones beneath the tendon of the short extensor, and anastomoses with small branches of the external plantar. From the concavity of the arch which it forms, small twigs ascend to the tarsus, from the convexity proceed four interosseous branches. These run forwards along the interosseous spaces, bifurcating opposite the webs of the toes to supply the dorsal aspect of the latter. From the commencement of each interosseous artery is given off a posterior perforating branch of minute size, which passes downwards to anastomose with the interosseous branches of the deep plantar arch; similar anterior perforating branches leave each joint before its bifurcation. The branch, *c*, which anastomoses with the anterior peroneal, may be looked upon as a second external malleolar.

To ligature the dorsal artery of the foot, an incision an inch and a half long is made over the course of the vessel; the most internal tendon of the extensor brevis digitorum is separated from that of the extensor longus digitorum, and the artery is sought between them.

VEINS.

Venæ comites accompany the dorsal artery of the foot and the anterior tibial.

NERVES.

The peroneal nerve after entering, or rather passing beneath the peroneus longus, divides into three branches, the anterior tibial, the recurrent articular, and the musculo-cutaneous. The relation of the termination of the peroneal nerve to the head of the fibula exposes it to the risk of undue pressure, from insufficiently padded splints applied to the outer side of the limb. Temporary, or even permanent, injury to the nerve may arise from this cause.

The *anterior tibial nerve*, 2, passes downwards and inwards, beneath a tendinous arch from which the peroneus longus arises, towards the anterior tibial artery which it joins about the middle of the leg. It crosses the artery once or twice in its course downwards, but usually lies external to the end of this vessel and to the dorsal artery of the foot. It ends by supplying a digital branch to the back of the contiguous sides of the inner two toes, which joins some twigs from the musculo-cutaneous. In the leg the anterior tibial supplies muscular branches to the tibialis anticus, the extensor communis digitorum, and the extensor proprius pollicis. In the foot, it gives off a considerable branch, 3, which runs forwards and outwards beneath the extensor brevis digitorum, supplying this muscle and the articulations of the foot. This branch is supplied with a gangliform enlargement.

The *recurrent articular*, 1, runs upwards and inwards in the fibres of the tibialis anticus, supplying this muscle and the knee, as well as the tibio-fibular articulation. In this instance it gave a twig to the peroneus longus.*

The *musculo-cutaneous*, 4, runs almost vertically downwards through or beneath the peroneus longus, and then between the peroneus brevis and the extensor longus digitorum as far as a point somewhat below the middle of the leg, where it becomes superficial and divides into its two terminal branches. It supplies muscular branches to the two outer peronei. The inner division gives cutaneous digital branches to the inner side of the great toe, and the contiguous sides of the second and third toes, joining with the internal saphenous and the anterior tibial; while the outer supplies the contiguous sides of the third and fourth, and of the fourth and fifth toes, and joins the external saphenous nerve. Cutaneous twigs are also given to the lower part of the leg and to the dorsum of the foot.

* This nerve is sometimes described as a muscular or as an articular branch either of the external popliteal (Sappey), or of the anterior tibial (Henle).

PLATE 46.

FIG. 1.

This drawing illustrates the superficial dissection of the sole of the foot. For its preparation all that is required is a transverse incision across the web of the toes, and others carried round the inner and outer borders of the foot at the heel. After dissecting the cutaneous vessels and nerves, the *plantar fascia* and the ends of the digital vessels were removed. The skin was removed from the lower aspect of the tarsal tunnel, and the prolongation of the *plantar fascia* to each was displayed, as well as the ends of the digital vessels and nerves.

ARTERIES.

The cutaneous branches to the sole are derived, at the inner border from the *internal plantar*, at the outer from the *external plantar*; the calcaneal branch of the *posterior tibial* sends twigs to the heel, and the digital vessels arise from the *plantar arteries* and the dorsal artery of the foot.

NERVES.

The cutaneous nerves are supplied by the calcaneal branch of the *posterior tibial* and by the *plantar nerves*, the latter supplying all the digital nerves.

The *plantar fascia* has an important function to fulfil in helping to maintain the arch of the foot, and it also serves to bind together the numerous structures which occupy the sole. Viewed superficially, it consists of three parts, a very strong central portion and two much weaker lateral ones. The central portion, +, is made of glistening white fibres arranged longitudinally, but diverging to each side at the front of the foot. It is very thick indeed behind, where it is firmly

attached to the inner of the two tubercles on the lower surface of the os calcis, but much thinner in front, where it divides into five distinct slips, which are prolonged forward to blend with the under surfaces of the sheaths of the flexor tendons of the toes. Soon after the subdivision of this part of the fascia, each slip sends upwards a prolongation on either side of the flexor tendons to be attached to the transverse metatarsal ligament. Over the webs of the toes the five slips are joined together by a thin and often indefinite transverse band, the *superficial transverse ligament*. From the under surface of the central piece of the fascia the flexor brevis digitorum takes origin.

The two *lateral portions of the plantar fascia*, †, *, which are comparatively thin, and allow the colour of the subjacent muscles to show through, are attached behind, like the central part, to the os calcis; the internal to the inner of the two tubercles on the under surface, the external to both. They pass forwards over the abductors of the great and little toes respectively, giving origin to these muscles, and being united with the sides of the central portion. The inner also blends with the internal annular ligament and is attached to the bones at the inner side of the foot; and the outer portion joins the fascia on the outer side of the foot. Between the calcaneum and the base of the fifth metatarsal bone the external piece forms a strong band of fibres, which act the part of a ligament holding these bones together. If we examine the plantar fascia further, we find passing upwards towards the deeper parts of the foot, from the junction of the central and lateral portions, strong intermuscular septa which separate the three muscles of the first layer; and these septa are joined again by a transverse piece which lies on the deep or upper surface of the flexor brevis digitorum.

FIG. 2.

This dissection was made from the last, by removing the plantar fascia, and cleaning all the structures exposed by so doing.

MUSCLES.

The following muscles belong to what is usually described as the *first layer* in the sole :—

The *flexor brevis digitorum*, A, arises by a narrow origin from the inner tubercle on the under surface of the os calcis, and from the plantar fascia and the intermuscular septa. It forms a rounded fleshy belly, which occupies the middle of the sole and divides into four slips, from which tendons are prolonged to the four smaller toes. These tendons split opposite the metatarso-phalangeal joints, to allow the tendons of the long flexor to pass through them. After this has happened, the two parts reunite opposite the first phalanx, and again splitting, are inserted on the sides of the base of the second phalanx. The muscle rests upon the tendons of the flexor longus digitorum and the lumbricales, the accessorius, the external plantar vessels and nerve, and the long plantar ligament. It acts as a flexor of the metatarso-phalangeal and first inter-phalangeal joints of the four outer toes.

The *abductor pollicis*, B, arises from the inner of the two tubercles on the under surface of the os calcis, from the plantar fascia, and from the internal annular ligament. A strong tendon appears on the under surface near the posterior part of the muscle, and running forwards and slightly inwards, receives fibres of insertion from the flexor brevis pollicis as well as from the abductor itself; it is inserted, together with the inner head of the former muscle, into the inner side of the base of the first phalanx of the great toe. The muscle lies over the insertions of the tibialis posticus and the tibialis anticus, and part of the flexor brevis pollicis, the tendons of the flexor longus pollicis and flexor longus digitorum, the inner

head of the accessorius, and the plantar vessels and nerves. It is a flexor and a weak abductor of the great toe from the middle line of the foot.*

The *abductor minimi digiti*, C, arises from both tubercles on the under surface of the os calcis and from the interval between them, and also from the plantar fascia, especially that part which extends from the calcaneum to the fifth metatarsal bone. Beyond the level of the base of this bone it is chiefly tendinous, and is closely united with the flexor minimi digiti. The two muscles are inserted together to the outer side of the metatarsal phalanx of the little toe.

ARTERIES.

The *internal plantar*, a, is an artery which varies considerably in size and distribution. It begins at the point of division of the posterior tibial artery, usually at the lower border of the internal annular ligament, but sometimes at a higher, sometimes at a lower level. The vessel passes forwards, perforating the internal intermuscular septum, and becoming superficial near the middle of the foot between the flexor brevis digitorum and the abductor pollicis. It then courses forwards along the inner side of the foot and anastomoses with the digital arteries of the great toe; sometimes an insignificant trunk is continued outwards and forwards across the tendons of the flexor brevis digitorum, giving minute branches to join the digital vessels in the first two or three spaces. The internal plantar supplies branches to the contiguous muscles, cutaneous twigs to the inner part of the sole, and usually a considerable branch to the inner side of the dorsum of the foot. See Plate 38, Fig. 2.

* See also note on action of flexor brevis pollicis.

NERVES.

The *internal plantar*, 1, is somewhat the larger of the two plantar nerves. It takes the same course as the accompanying artery as far as the point, where both become superficial between the abductor pollicis and the flexor brevis digitorum. The nerve supplies digital branches to the inner side of the great toe and to the contiguous sides of the four inner toes; muscular branches to the abductor and flexor brevis digitorum, flexor brevis pollicis, and the inner two lumbricales; and cutaneous branches to the inner side of the sole. It also joins, or is joined by, a twig from the external plantar nerve.

FIG. 3.

In order to make this dissection from the last, the internal plantar vessels and nerves were removed. The abductors of the great and little toes, and the flexor brevis digitorum, were detached at their origins, and their tendons were cut near the toes. The subjacent parts were then carefully cleaned.

MUSCLES.

The muscles of the *second layer* are now exposed.

The tendons of the *flexor longus pollicis*, D, and the *flexor longus digitorum*, E, are shown as they pass forward to the toes. That of the flexor longus pollicis is more deeply situated than that of the flexor of the toes, and as it crosses beneath the latter the two are united by cross fibres. The reader will notice how the tendon of the flexor longus pollicis is flattened out beneath the metatarso-phalangeal joint, and also the manner in which the tendons of the long flexor of the toes perforate those of the short flexor.

The *lumbricales*, L, L, L, are small muscles, commonly four in number (in this case only three), arising from the tendons

of the flexor longus digitorum. All except the innermost are attached to two tendons. They are inserted into the expansions at the dorsal aspect of the toes formed by the tendons of the extensor longus digitorum. Their action is like that of the corresponding muscles in the hand—viz., to flex the metatarso-phalangeal, and to extend the inter-phalangeal, articulations.

The *accessorius*, F, F', is a small flat muscle occupying the middle of the sole. It arises by two heads, an inner fleshy one attached to the inner surface of the os calcis, and an outer tendinous one attached to the outer surface of the same bone, and also to the long plantar ligament. The muscle is inserted on the outer border and deep surface of the tendon of the long flexor. It is crossed by the plantar vessels and nerves and by the flexor brevis digitorum, and it lies on the calcaneum and the ligamentum longum plantæ. Its action is to counteract the tendency of the long flexor to pull the toes towards the inner border of the foot.

FIG. 4.

This drawing exhibits the next stage in the dissection of the sole, and is obtained from that shown in Fig. 3 by cutting the tendons of the long flexors of the toes below the annular ligament and near their insertions, and by removing them together with the *accessorius*. The short muscles of the great and small toes, and such of the interossei muscles and the ligamentous structures as were exposed, were then cleaned, together with the continuation of the external plantar vessels and nerve. Lastly, the sheath of the peroneus longus was in part opened to show the tendon of the muscle, O.

MUSCLES.

The muscles of the *third layer* are now seen.

The *flexor brevis pollicis*, G, is a muscle consisting of two heads,

more or less closely united behind but diverging in front, and receiving between them the tendon of the flexor longus pollicis. It arises from the inner surface of the cuboid bone, and from the prolongation of the tendon of the tibialis posticus to the cuneiform bones. The two heads of insertion blend with the tendons of the abductor and adductor of the great toe respectively, and by means of these are inserted into the inner and outer sesamoid bones of the metatarso-phalangeal articulation and the sides of the base of the first phalanx of the great toe. The muscle lies over the first metatarsal bone and the tendon of the peroneus longus. The action of the short flexor is to flex the metatarso-phalangeal articulation ; but it probably does not act independently of the abductor and adductor.

Duchenne ("Phys. des Mouvements," pp. 580-585), following the description of Winslow, gives the inner part of the muscle as part of the abductor, and the outer as part of the adductor. He considers that one of the principal functions of the muscles attached to the sesamoid bones of the great toe is to fix the first phalanx during the contraction of the extensor proprius pollicis, so that this muscle may act as a flexor of the ankle without extending the great toe.

The *adductor pollicis*, H, arises from the sheath of the peroneus longus and from the bases of the second, third, and fourth metatarsal bones. Its fibres pass forwards and inwards to be inserted with the flexor into the outer sesamoid bone and the outer side of the base of the first phalanx of the great toe. It is in contact by its deep surface with the metatarsal bones and some of the interossei, and by the opposite surface with the tendon of the long flexor of the toes. It acts as a flexor and a weak adductor of the great toe.

The *transversalis pedis*, J, is sometimes looked upon as a part of the adductor, its insertion taking place together with that of this muscle into the outer sesamoid bone of the great toe, and the outer side of the base of the first phalanx. The *transversalis* arises from the under surface of the capsular ligament

of the outer four metatarso-phalangeal articulations. It crosses the digital arteries to the three outer spaces, and is crossed by the tendons of the long flexor. Its action is to draw the heads of the metatarsal bones together.

The *flexor brevis minimi digiti*, K, arises from the sheath of the peroneus longus and the base of the fifth metatarsal bone, and is inserted to the outer side of the base of the metatarsal phalanx of the same toe. The muscle is not unlike one of the interossei; it acts as a flexor of the metatarso-phalangeal joint of the little toe.

ARTERIES.

The *external planter*, c, begins at the bifurcation of the posterior tibial, close to the lower border of the internal annular ligament. It is at first directed obliquely forwards and outwards across the foot, beneath the abductor pollicis and flexor brevis digitorum, but resting upon the accessorius and the long plantar ligament. Near the base of the fifth metatarsal bone it lies opposite the interval between the flexor brevis digitorum and the abductor minimi digiti. It then changes its direction, and passes forwards and inwards on the interossei muscles and metatarsal bones, and under cover of the flexor brevis digitorum and adductor pollicis, till it ends by inosculating with the terminal branch of the dorsal artery of the foot (Fig. 5). This junction forms what is known as the plantar arch. The external plantar nerve is in close contact with the artery, lying to its inner side. The external plantar artery gives cutaneous branches to the heel and outer side of the foot, which have been before described as anastomosing freely with the other vessels in these situations. It gives also muscular branches to the muscles between which it lies, and articular offsets to the joints which it crosses. From the convexity of the plantar arch spring the *digital branches*, d, d. These are four in number; the outermost one is undivided, and supplies the outer side of the little toe; the others pass beneath the transversalis pedis, and

each divides opposite the web of the toes into two pieces, which supply the contiguous sides of the four outer toes. The digital branches send upwards through the three outer interosseous spaces, anterior perforating branches to join the interosseous twigs derived from the dorsal artery of the foot. The distribution of the vessels at the sides of the toes is similar to that which will be described in connection with the hand. From the concavity of the plantar arch, minute articular and muscular twigs are supplied, and from its upper surface three posterior perforating arteries ascend through the interosseous spaces to join the interosseous arteries on the dorsum of the foot.

The *dorsal artery of the foot* (Fig. 5, *d*) passes into the sole at the back of the first interosseous space, and divides at once into two parts; the outer enters into a free inosculation with the external plantar arc; the inner is continued forwards beneath the flexor brevis pollicis, and divides into two branches, one of which supplies the inner side of the great toe after joining, in most cases, a branch from the internal plantar, while the other again divides to supply the contiguous sides of the two inner toes.

NERVES.

The *external plantar*, 2, begins at the bifurcation of the posterior tibial nerve, and accompanies the artery of the same name in the whole of its course. In the first part of its course, the nerve gives branches to the accessorius and abductor minimi digiti, that to the latter muscle winding outwards immediately in front of the great tubercle on the under surface of the os calcis. It also gives off some cutaneous twigs to the outer side of the sole. Near the base of the fifth metatarsal bone the nerve divides into superficial and deep parts. The superficial supplies the digital branches to the outer side of the little toe, and to the contiguous sides of this toe and the next; it also supplies the flexor brevis minimi digiti, and communicates with the outermost digital branch of

the internal plantar. The deep part of the nerve ends in the adductor pollicis, and supplies muscular twigs to this muscle as well as to the outer head of the flexor brevis pollicis, the transversalis pedis, the interossei, and the outer two lumbricales.

FIG. 5.

This deepest view of the sole of the foot is obtained from the dissection shown in Fig. 4, by removing all the muscles of the third layer and cleaning carefully the parts so exposed.

MUSCLES.

The remaining muscles belong to the *fourth layer*.

The *interossei* are a series of small muscles occupying the interosseous spaces; they are arranged in two sets, dorsal and plantar, all, however, being visible from below.

The plantar set, L, L, L, three in number, take origin from the inner aspect of the three outer metatarsal bones, and are inserted on the bases of the first phalanges, blending at their insertion with the expansion of the extensor tendons on the dorsal aspect of these bones. The dorsal are four, M, M, M, M, and take origin each from both of the bones bounding respectively the four interosseous spaces; they are inserted in the same way as the plantar muscles, into the expansion on the dorsal aspect of the toes, the innermost one being attached to the inner side of the second toe, and the others to the outer sides of the second, third, and fourth toes. These muscles act, like the lumbricales, as flexors of the metatarso-phalangeal articulations, and extensors of the two inter-phalangeal joints, of the toes;* but they also can separate

* The principal use of the lumbricales and interossei is to keep the pulps of the toes applied to the ground in the acts of walking and standing; if they be paralysed the deformity of the toes known as "la griffe des orteils" is produced, in which condition the metatarso-phalangeal joint is extended, while the inter-phalangeal joints are flexed.

and approximate the toes. The plantar series are adductors towards, and the dorsal series abductors from, the middle line of the second toe.

The *tendon of the peroneus longus*, J, occupies the groove on the under surface of the cuboid bone; at this point a sesamoid bone is generally found in it, giving it the swollen appearance shown in the drawing; it passes obliquely across the sole in a fibrous sheath (indicated in Fig. 4), and is inserted into the base of the first metatarsal bone at its outer aspect, but sends also a few fibres to the outer side of the internal cuneiform bone.

The *tendon of the tibialis posticus*, C, is attached to the tubercle of the scaphoid bone, and sends strong prolongations to several other bones of the foot; one, D, passes outwards and backwards to the anterior edge of the sustentaculum tali; another, E, reaches the under surface of the internal cuneiform; and a third, F, goes to the inner side of the cuboid, to the two outer cuneiform bones, and to the base of the three middle metatarsal bones.

PLATE 41.

THIS drawing represents a dissection of the axilla and the surrounding regions, showing the parts as nearly as possible in their natural position. Incisions in the skin were made from the episternal notch; one vertically downwards to a point midway between the xiphoid appendix and the umbilicus, another along the clavicle as far as the outer end of this bone. From this point a cut was made along the middle of the swell formed by the deltoid muscle for about a third of the length of the arm; from its extremity another was carried across the inner aspect of the arm as far as the swell formed by the long head of the triceps, and was thence prolonged vertically downwards along the side of the trunk, running about three inches behind the posterior fold of the axilla. When this last incision had reached a point on the same level as the lower end of that first mentioned in the middle line, the two were united by a transverse cut.

The cutaneous vessels and nerves were first dissected, and a plan of them was laid down on paper. Then the deep fascia was removed from the muscles, and the fat with most of the glands was carefully cleared away from the axilla, exposing the various structures which this space contains. The axilla may be looked upon as a hollow four-sided pyramid, the base of which looks downwards and outwards, and the apex upwards and inwards. Of its four sides, the inner is formed by the chest-wall, covered in great part by the serratus magnus; the anterior, by the two pectoral muscles; the posterior, by the subscapularis, the latissimus dorsi and the teres major; while the outer one, comparatively insignificant in size, is formed by the neck of the humerus covered by the coraco-brachialis and short

head of the biceps. The base of the pyramid is closed by the axillary fascia, which is strong and white, and is continuous with the fascia of the arm and that of the side of the trunk, as well as with the sheaths of the muscles forming the *anterior and posterior folds of the axilla*—i.e., the pectoralis major and minor in front, and the latissimus dorsi and teres major behind. Along the outer wall are arranged the axillary vessels and the brachial plexus of nerves; at the posterior part are found the subscapular vessels, and crossing the space, from above downwards, are branches derived from the brachial plexus, and from within outwards the intercostal nerves. The axilla is occupied by a large amount of loose fat, imbedded in which are numerous *lymphatic glands*, †, †. These glands are of great interest to the surgeon on account of the frequency with which he is called upon to undertake their removal. They are not very definitely arranged, but tend to group themselves in three sets: one, along the course of the great vessels, which draw their supply of lymph from the upper limb; and two others along the inner wall of the axilla—i.e., one along the edge of the pectoralis minor, and one at the back of the space near the subscapularis. These latter communicate with the superficial lymphatics of the front and sides of the chest and the mamma, and with those of the lumbar and dorsal regions. It may also be mentioned that a few small glands are sometimes to be found in front of the chest between the pectoralis major and the deltoid. The efferent vessels from the axillary glands unite into one or more trunks which pass up into the lower part of the posterior triangle of the neck, and empty themselves either into the subclavian vein, near the point of entry of the thoracic duct, or else open into the thoracic duct or right lymphatic duct, or one of their large tributaries. In connection with this point, it may be remembered that, although it is of frequent occurrence after cancer has affected the axillary glands to find those above the clavicle subsequently affected, yet cases occasionally present themselves where a secondary growth has started in an

internal viscus before the supra-clavicular glands have become involved. In operating for the removal of tumours of any kind in the armpit, the surgeon must bear in mind that, while the knife may be used freely at the anterior and inner parts of the space, great caution must be used in the direction of the large vessels; he will find it a useful plan to pull the growth away from these structures with his fingers, applying ligatures to all arteries and veins before dividing them. During such an operation it is scarcely possible to avoid dividing some of the nerves, but it is well to endeavour to preserve the subscapular nerves and the branch to the *serratus magnus*, injury to which will seriously impair the usefulness of the arm. The axillary fascia is tightened by abduction of the arm, and under such circumstances forms a serious obstruction to the diagnosis of tumours beneath it, and to the perception of the sense of fluctuation. A small cancerous gland in the axilla will often, indeed, completely elude detection, until the finger is passed through the axillary fascia.

MUSCLES.

Several muscles are partly exposed in this dissection, but only one, the *pectoralis major*, is completely laid bare. Beneath the clavicle will be seen the lowest part of the *platysma*, M, ending on the aponeurosis over the *pectoralis major*.

The *pectoralis major*, A, arises from the anterior border, or, as it may be called, the anterior surface of the clavicle, in the inner half of the bone; from the front of the sternum by muscular and tendinous fibres closely united with those of the muscle of the opposite side; and by slips, which are muscular in the upper part of the chest and aponeurotic in the lower, from the cartilages of the upper six ribs. These points of attachment are shown in the following Plate (Plate 42, Fig. 1, A, A, &c.). It is also attached to the aponeurosis of the external oblique muscle of the abdomen, and sometimes to the bone of the sixth rib. There is always a more or less distinct interval

between the sternal and clavicular portions of the muscle. The insertion is to the outer lip of the bicipital groove. The upper sternal and costal fibres end in a tendon which blends with the deep surface of that derived from the clavicular fibres, but which reaches neither so far upwards nor downwards. The tendon corresponding to the lower costal fibres unites at its lower part with the middle of the under surface of the tendon from the upper sternal and costal part; but above, the two are separated by a considerable interval containing fat. This deepest tendon reaches furthest up upon the bone.

The muscle is subcutaneous, except where the platysma and the mamma cover it; it rests upon the pectoralis minor and parts of the coraco-brachialis and short head of the biceps, and upon the upper ribs and their intercostal muscles. Above the level of the pectoralis minor it covers the costo-coracoid membrane with the subclavius muscle, the sheath of the axillary vessels and the brachial plexus; below the pectoralis minor it rests on the axillary vessels and the accompanying large branches of the brachial plexus. The upper edge corresponds to the deltoid and the cephalic vein.

The principal action of the pectoralis major is to adduct the arm, at the same time bringing it forwards across the front of the body. It also rotates the humerus inwards. The lower fibres depress the arm when it is raised. The clavicular fibres have a somewhat independent action from that of the rest of the muscle; they act very forcibly in bringing the arm forwards, if it have been previously raised to a level with the shoulder; they depress the arm if raised above the head, but if the arm be applied to the side, they raise the shoulder by their contraction, at the same time bringing the elbow forwards, as is done in supporting a weight on the shoulder. The muscle may be used in climbing, or as an extraordinary muscle of inspiration, under which circumstances the humerus is the fixed point, and the body or the ribs, as the case may be, are drawn towards it.

The *latissimus dorsi*, F, is more fully seen here than in any other of this series of Plates, but parts of it are shown in Plate 43 and in Plate 26. With an origin partly shown in these Plates, from the spines of the lower six dorsal and all the lumbar vertebræ, from the posterior layer of the fascia lumborum, from the outer half of the iliac crest, and by three digitations, from the lowest three ribs, the latissimus is at first a broad flat muscle, the fibres of which ascend and pass outwards in the direction of the lower angle of the scapula. Here it receives in many cases a slip of origin from the lower angle of the scapula (Plate 43, Fig. 1), and then becomes applied to the surface of the teres major, G, round which it gradually winds, so that at the insertion of the two muscles the latissimus is placed anterior to the teres, and at a somewhat higher level. The insertion takes place at the bottom of the bicipital groove, the tendon being continuous at the lower part with that of the teres major, but separated from it above by a narrow interval, in which is found a bursa.

The muscle is subcutaneous for the most part, but behind, its upper border is overlapped by the trapezius (Plate 26, Fig. 1), and at its insertion it is beneath the axillary vessels and the accompanying nerves, and here it is overlapped by the coracobrachialis. It rests on the erector spinæ, the lower ribs and intercostal muscles, and the serratus posticus inferior; on a small part of the external and internal oblique, on the lower part of the serratus magnus; on the angle of the scapula with the lower part of the rhomboideus major and infra-spinatus muscles, and upon the teres major.

Its action is to depress the arm and draw it backwards, while rotating the humerus inwards. If the arm be raised, it will draw the trunk towards it, as in climbing.

ARTERIES.

The cutaneous arteries on the front of the chest are derived principally from the minute *perforating branches of the internal*

mammary, e, but a few, which accompany the descending nerves from the cervical plexus, come from the supra-scapular or some other branches of the subclavian. At the side of the chest the arterial supply comes chiefly from the *lateral branches of the aortic intercostals, f*, which divide into anterior and posterior twigs to accompany the corresponding cutaneous nerves; a few small vessels, however, at the upper part of the axilla, originate from some of the branches of the axillary artery.

NERVES.

The cutaneous nerves come almost entirely from the cervical plexus and the intercostal nerves.

Descending over the clavicle and making their appearance beneath the lower part of the platysma are the *descending branches of the cervical plexus, 12, 12* (*vide* Plate 5, Fig. 1, p. 51). They are usually grouped in three sets: *acromial, clavicular, and sternal*, but their arrangement is variable, and, moreover, their size varies with that of the terminal branches of the intercostal nerves. They may roughly be said to supply the skin of the front of the chest above the level of the nipples; a fact which may be interesting as a point of diagnosis in certain cases of fracture of the lower cervical spine.* Along the front of the chest appear the *terminal twigs of the intercostal nerves, 11*, two for each space; these run outwards over the pectoralis major. In each intercostal space, except usually the first, are found the *lateral branches of the intercostal nerves*. Their points of emergence from between the digitations of the serratus magnus, or through the external oblique, are in a line drawn from the anterior fold of the axilla to the middle of the iliac crest. All but the highest (the intercosto-humeral) divide into anterior and posterior branches, which pass respectively forwards and backwards, supplying the area of skin which lies

* I know of a malingerer who was detected from the fact that he professed to have lost sensation absolutely, below a line corresponding to his clavicles. The application of the battery quickly exposed the deceit.

between that to which the anterior and posterior cutaneous branches of the dorsal nerves are distributed. The *posterior branch of the third*, 8, usually goes, in part, to the skin of the arm. The *lateral branch of the second*, the *intercosto-humeral*, 7, is undivided, and passes altogether to the inner and back part of the arm. The first usually gives no lateral offset; but occasionally, as in this instance, it supplies a branch, 5, having the distribution of the *nerve of Wrisberg*, or *small internal cutaneous*. If such a nerve be present, it is generally joined by a branch from the brachial plexus, such as that shown in the drawing.

PLATE 42.

FIGS. 1 AND 2.

THE dissection for Fig. 1 was prepared from that shown in Plate 41, by dividing the pectoralis major and removing the greater part of the muscle, leaving, however, its origin and insertion. The first five digitations of the external oblique were also taken away, with a portion of the aponeurosis of the pectoralis. The parts exposed by this dissection were then cleaned, and in order to display more fully the structures at the outer aspect of the axilla the latissimus dorsi was cut across and the lower end of the muscle was allowed to fall backwards. Lastly, about five inches of the vein which is called basilic below, but axillary above, were removed, and most of the cutaneous nerves were cut short.

Fig. 2 shows a part of the same preparation as that drawn in Fig. 1, after the removal of the pectoralis minor, the sheath of the axillary vessels, and the axillary vein.

On the removal of the pectoralis major, a space of some importance is disclosed above the pectoralis minor. This is at first covered by a thin prolongation from the sheath of the latter muscle, but on clearing away this structure and some fat which lies beneath it the costo-coracoid membrane is laid bare, with a layer of fascia passing from it to the sheath of the axillary vessels. Piercing this prolongation are found the external anterior thoracic nerve, the acromio-thoracic artery and the cephalic vein. The *costo-coracoid membrane*, †, is a strong piece of fascia consisting of two layers, which correspond to the anterior and posterior surfaces of the subclavius muscle, being attached above to the two lips of the subclavian groove on the

under surface of the clavicle to which this muscle is attached. They meet below at an acute angle and thus form a sharp edge which lies over the commencement of the axillary artery. This is well shown in Fig. 2, †, from which it will easily be understood that while the inner part of the costo-coracoid membrane is attached to the first rib and to its cartilage, round the origin of the subclavius, the outer part is fixed to the inner border of the coracoid process.

MUSCLES.

The *pectoralis minor*, Fig. 1, B, arises from the third, fourth, and fifth ribs (often, as in this case, also from the second), near their cartilages and from the intercostal fascia. The heads of origin are attached to the upper border and outer surface of the ribs and blend almost immediately to form a triangular muscle, which becoming tendinous is inserted into the anterior part of the inner border of the coracoid process. The insertion is united by fascia with the origin of the coraco-brachialis. The muscle is almost completely covered by the pectoralis major, and corresponds by its deep surface to some of the ribs and intercostal muscles, to part of the serratus magnus, and to the axillary vessels and the brachial plexus of nerves. The pectoralis minor draws the scapula down and keeps it applied to the chest-walls. It may perhaps rotate it slightly, bringing the outer angle downwards and forwards, and so acting in common with the rhomboids.

The *serratus magnus*, Fig. 1, K, arises from the upper eight or nine ribs at the lateral part of the chest, and is inserted into the posterior border of the scapula. The first digitation, which is often wrongly described as double, arises from the outer border of the first rib and the outer surface of the second rib, and from a tendinous arch (*see* Fig. 2), between them it forms a distinct slip which passes backwards to the triangular mark at the upper angle of the scapula on the ventral surface. The next digitation comes from the lower border of the second rib, and is very wide and thin; it spreads out in a fan-shape, and

uniting with the digitation from the third, or third and fourth ribs, is attached to the whole of the posterior border of the scapula. The remaining digitations constitute by far the strongest part of the muscle; they converge rapidly towards the triangular mark on the ventral aspect of the lower angle of the scapula, to which they are inserted. The serratus rests upon the ribs and the intercostal muscles; its outer surface is partly subcutaneous and partly forms the inner wall of the axilla, but it also touches the pectoralis major, pectoralis minor, latissimus dorsi, teres major, and subscapularis, as well as the great vessels and nerves of the axilla. The upper digitation, as we have before seen (Plate 5, Fig. 1), forms part of the floor of the posterior triangle of the neck.

The action of the muscle, if all the fibres contract at once, is to draw the scapula forwards, at the same time that, with the assistance of the rhomboids, the posterior border of the bone is kept applied to the chest-walls. Should the lower, and stronger, part of the muscle contract, the scapula will receive a movement of rotation, by which the glenoid cavity will be tilted upwards. The serratus has little or no action as a respiratory muscle. In paralysis of the serratus, as in paralysis of the rhomboids, the angle of the scapula projects markedly from the surface of the body, and the principal movement impaired is that of raising the arm above the level of the shoulder.

The *subscapularis*, Fig. 1, J, arises from the whole of the venter of the scapula, except from those surfaces to which the serratus is attached, and the neck of the bone. It also arises from the groove along the axillary border of the scapula. Tendinous layers are found in the interior of the muscle, which are attached to the oblique ridges on the ventral aspect of the scapula. The muscle is inserted into the small tuberosity of the humerus, and by a narrow prolongation, into the ridge below, for an inch or more. It rests on the venter of the scapula and the inner part of the shoulder-joint. A bursa intervenes between the muscle and the neck of the scapula, which

communicates with the shoulder-joint. By its anterior surface the muscle touches the serratus magnus, and is crossed by the axillary vessels, and the accompanying nerves with some of the branches derived from both; by its lower border it is in contact with the teres major, and corresponds exactly with the lower edge of the teres minor. Its action is to rotate the humerus inwards, while the lower fibres adduct the arm.

ARTERIES.

The *axillary*, Fig. 1, *a*, is the continuation of the subclavian trunk, and extends from the outer border of the first rib to the lower border of the teres major. Its position may be marked on the front of the chest, by a line drawn from the mid-point of the clavicle—i.e., the most prominent part of its anterior convexity—to the inner border of the coraco-brachialis muscle; or in the axilla, when the arm is abducted, it may be indicated by dividing the space between the two folds into thirds, by lines drawn parallel to them towards the arm, and taking the anterior of the two lines as that corresponding to the artery. For the sake of description, the vessel is usually divided into three parts, one above, another behind, and the third below the pectoralis minor.

The *first part* is enclosed in a *fibrous sheath* derived from the deep fascia of the neck, and especially from that part of it which is in relation with the scalene muscles. Covering the anterior surface of this part of the artery are the pectoralis major and the costo-coracoid membrane, and crossing it are the branches of the acromio-thoracic artery, as well as the cephalic vein and the external anterior thoracic nerve. The artery here rests on the first intercostal space, the first digitation of the serratus magnus, and the nerve to this muscle. The axillary vein lies to its inner side, and the cords of the brachial plexus to the outer side. The *second part* is covered by the pectoralis minor; the posterior cord of the brachial plexus lies behind it; the inner cord and the axillary vein are to the inner side of the vessel, and the outer cord and the head of the

humerus to the outer side. The *third part* is the longest. It is covered above by the pectoralis major; below, it is subcutaneous, but the internal cutaneous nerve usually is in contact with the anterior surface of the artery, which is also crossed by the inner head of the median. The vessel rests upon the subscapularis, the latissimus dorsi, and the teres major, as well as upon the circumflex and musculo-spiral nerves. To the inner side are the basilic vein and the inner head of the median, the ulnar and the small internal cutaneous nerves; and to the outer side, the coraco-brachialis muscle, the median and the musculo-cutaneous nerves, and often the termination of one of the venæ comites of the brachial artery. This vena comes, if it reach so high, is often seen, as in the present instance, crossing the axillary artery near the lower border of the pectoralis minor.

Ligature of the axillary artery is usually practised in the lower third. According to one method, the arm being abducted, an incision is made in the axilla for three inches in the line indicated above, as that marking the course of the vessel; the surgeon then divides one by one the integumentary structures until the vein appears, this he pulls inwards, and at once comes upon the artery surrounded by the large nervous cords. The plan recommended by Malgaigne is obviously a better one—viz., to make the incision on the edge of the coraco-brachialis; the median nerve is first seen, and the artery may be reached from the front without in any way exposing the vein. Should it be necessary to perform the difficult operation of tying the vessel in the first part, an incision three inches long, parallel to and a little below the clavicle, reaching nearly to the sternum, or a semicircular one from the sterno-clavicular articulation to the coracoid process, is to be made through skin and fasciæ. The pectoralis major is then divided to the same extent. It will be necessary afterwards to work carefully through the cellular tissue beneath the muscle, with a blunt instrument, pulling the pectoralis minor down, until the sheath of the vessels is

reached. It need hardly be pointed out that the bleeding during this operation is likely to be very troublesome, while, at the same time, the cases in which the easier ligature of the third part of the subclavian is not equally suitable must be extremely rare.

The branches of the first part of the axillary artery are two in number: the superior thoracic and the acromio-thoracic. The *superior thoracic*, Fig. 1, *b*, Fig. 2, *b*, is a small twig distributed over the upper one or two intercostal spaces. The *acromio-thoracic*, Fig. 1, *c*, Fig. 2, *c*, arises at the upper border of the pectoralis minor, and sends branches in three directions, the largest pass inwards for the supply of the pectoralis major, anastomosing with the perforating branches of the internal mammary; another set pass outwards towards the deltoid, some offsets of which anastomose in the muscle with the posterior circumflex, one reaches the acromion and anastomoses with the branch of the supra-scapular (p. 389) found in this situation, another runs down in the interval between the deltoid and the pectoralis major, accompanying the cephalic vein. The smallest set of branches derived from the acromio-thoracic ascend towards the clavicle and supply the subclavius.

The branches of the second part are the long thoracic and the alar thoracic. The *long thoracic* had no precise representative in this subject, but its place was partly supplied by the superior thoracic, partly by the branch, Fig. 1, *g*, of the subscapular. It usually arises near the lower border of the pectoralis minor, and keeping close to this border of the muscle, passes downwards, supplying it as well as the serratus and the skin. It anastomoses with the intercostal arteries. The *alar thoracic*, *d*, Fig. 1, Fig. 2, is a very irregular branch, the destination of which is to the axillary glands. A number of small vessels with this distribution are commonly supplied by the other branches of the axillary.

From the third part are given off the subscapular, the anterior circumflex and the posterior circumflex. The *subscapu-*

lar, e, Fig. 1, Fig. 2, the largest branch of the axillary, passes downwards near the posterior fold of the axilla. It supplies numerous unnamed branches to the surrounding parts, and one of more importance, the *dorsal scapular, f*, Fig. 1, Fig. 2, which runs backwards in the interval bounded by the subscapular muscle, the *teres major* and the long head of the *triceps*, and so reaches the back of the scapula. In its course backwards it sends a branch, the *infra-scapular*, to the ventral surface of the bone. The dorsal scapular will be again seen in the dissection of the back of the shoulder, Plate 43, as will also the posterior circumflex artery. The anterior circumflex is seen in Plate 45, and will be there described.

VEINS.

The *basilic vein*, Fig. 2, β , lies to the inner side of the axillary artery, and at a point which is subject to some variation, unites with the *venæ comites* of the brachial artery, after which it takes the name of *axillary*. A large *external vena comes* is often seen, as in Fig. 1, crossing the artery a little below the lower border of the *pectoralis minor*.

Two large veins accompany the subscapular artery, which anastomose below with the tributaries of the superficial epigastric vein. This communication may often be found enlarged in cases where pressure upon the *vena cava inferior*, as in *ascites*, impedes the return of blood from the lower parts of the body through the usual channel.

The *cephalic vein*, Fig. 1, β , Fig. 2, γ , lies in the interval between the *pectoralis major* and the *deltoid*. It pierces the prolongation from the *costo-coracoid membrane* to the sheath of the vessels, and empties itself into the upper part of the axillary vein. A branch is shown, Fig. 1, which pierces the *costo-coracoid membrane*, passing between the *subclavius muscle* and the *clavicle*. The *cephalic* itself not unfrequently takes this course, or it may pass over the *clavicle* to join the *external jugular*. It is sometimes joined by an external

jugular passing over the clavicle. It must be remembered that the cephalic vein is one liable to be injured in stabs of the chest, a condition which may be mistaken for injury to the axillary vein.

NERVES.

The branches of the inner and outer cords of the brachial plexus, as far as they are seen in the axilla, have been described in connection with Plate 5, at pp. 55, 57. Those of the posterior cord are now in part seen in Fig. 2.

The *subscapular nerves* are three in number; that which rises highest is the *short subscapular*, 7, and is distributed to the subscapularis; the next to arise is the *long subscapular*, 9 (Plate 41, 14), which is distributed to the latissimus dorsi; the lowest is the *nerve to the teres major*, which supplies branches to both the teres major and the subscapularis.

The *circumflex*, 6, is shown as it passes to the back of the arm through a space bounded by the long head of the triceps, the subscapularis, the humerus, and the teres major; it will be further seen in the following two Plates.

The *musculo-spiral*, 5, lies behind the axillary artery, and is continued down behind the arterial trunk. In this situation it gives off the *internal cutaneous branch*, Fig. 1, 10, which will be subsequently described.

It will be noticed that the nerve, Fig. 1, 11, which nearly corresponds in position with the nerve of Wrisberg, is in this case the lateral branch of the first intercostal. It enters into a free communication with the intercosto-humeral, Fig. 1, 12, and is joined lower down by a branch from the internal cutaneous.

PLATE 43.

FIG. 1.

THIS drawing shows the superficial muscles, vessels, and nerves in the region of the shoulder. An incision was made a little to the left of the middle line of the back, from opposite the ninth dorsal to the level of the first dorsal vertebra, whence it was carried obliquely outwards and upwards across the neck to the border of the trapezius. When this line was reached the cut passed downwards to the outer end of the clavicle, and next along the front of the prominence formed by the deltoid, almost to the insertion of this muscle. It was then continued across the back of the arm as far as the most prominent part of the projection formed by the long head of the triceps, and along this projection to the posterior fold of the axilla, whence it extended across the side of the trunk to the point from which the first incision started. After dissecting out the cutaneous structures and accurately noting their positions, the deep fascia was removed and the muscles were cleaned.

It will be noticed that when the arm is abducted, a triangular interval becomes visible behind the scapula, bounded by the posterior border of that bone and the diverging edges of the trapezius and latissimus dorsi muscles. In this space are seen, not only the lower part of the rhomboideus major, but also two ribs and an intercostal muscle, and a tendon of the sacro-lumbalis. At this point the posterior part of the thoracic wall is uncovered by muscle.

MUSCLES.

The *trapezius*, A, arises from the inner third of the superior curved line on the occipital bone, from the ligamentum nuchæ, and from the spines of the seventh cervical and all the dorsal vertebræ, and the corresponding supra-spinous ligaments. The origin is throughout aponeurotic ; above, the aponeurosis is thin and very adherent to the subcutaneous tissue ; in the rest of its extent it is strong and glistening, narrow for the most part, but wider in the lower cervical and upper dorsal region, and widening again at the extreme lower end. The fibres of the muscle converge towards the shoulder ; the upper ones are inserted to the outer third of the clavicle on its posterior border and upper surface, and the others follow in order, being attached to the inner border of the acromion and the upper lip of the posterior border of the spine of the scapula, as far as the tubercle at the apex of the small triangular smooth surface seen at its inner end, on which the tendon of the muscle glides. In front, the insertion is chiefly by short tendinous fibres ; over the acromion and spine of the scapula it is more tendinous, the fibres becoming more or less continuous with those of the deltoid. The lowest fibres end in a distinct triangular tendon corresponding to the smooth piece of bone at the inner end of the spine. The muscle is subcutaneous. It rests upon the splenius, the complexus, the levator anguli scapulæ, the serratus posticus superior, a small piece of the infra-spinatus, the rhomboids, the latissimus dorsi, and, between the last two muscles, upon the ribs and a small portion of the erector spinæ. It also covers the infra-spinatus, and the infra-scapular and transverse cervical vessels. The spinal accessory nerve is found beneath it. The superior border of the muscle forms the posterior boundary of the posterior triangle of the neck.

If the whole muscle contract at once, the scapula is drawn towards the spine, and rotated so that the glenoid cavity is turned upwards. The upper fibres, acting alone, either draw

up the outer end of the clavicle, thus raising the shoulder; or if the clavicle be fixed, they draw the head to one side, giving at the same time a rotation to the head, so that the face moves towards the opposite side. The lower fibres contracting alone, draw the scapula downwards.

The *deltoid*, C, is a triangular muscle which, when the arm is abducted, has almost the appearance of prolonging the trapezius down to the humerus. It arises by short tendinous fibres in front and a more distinct tendon behind, from rather less than the outer half of the clavicle along the anterior border of the bone, from the outer border of the acromion, and from the whole length of the lower lip of the posterior border of the spine of the scapula. The tendinous fibres are continuous over the acromion and spine with those of the trapezius; the longest come from the inner part of the spine. The fibres of the muscle are very coarse, and are arranged in a *multipenniform* manner; they converge towards a strong tendon which is inserted on a rough impression on the outer surface of the shaft of the humerus about the middle. The muscle is subcutaneous. It covers numerous structures, some of which are shown in Fig. 2 and in the following Plate, others may be seen in Plate 45. In front, it rests upon the coracoid process and parts of the muscles attached to it, upon the coraco-acromial ligament, the upper end of the humerus, and the capsule of the shoulder-joint, between which and the muscle is a large bursa; further back, it rests on the infra-spinatus, teres minor, and long and external heads of the triceps, and on the circumflex vessels and nerves. Its action is to abduct the arm, raising it to the level of the shoulder, and to keep the head of the humerus applied to the glenoid cavity. The anterior fibres bring forward the arm and the posterior carry it backwards.

The large bursa under the deltoid extends upwards beneath the acromion; it not unfrequently becomes the seat of inflammation; a collection of serum or pus in this bursa must be carefully diagnosed from suppuration in connection with the shoulder-joint.

The deltoid may be paralysed and atrophied from a variety of causes besides direct injury to the circumflex nerve, or general wasting diseases; the most notable of which are, blows on the shoulder, disease of the shoulder-joint, necrosis of the humerus, and lead-poisoning. It must be remembered that such a condition, while doing away with the rounded contour of the shoulder, which is due chiefly to the deltoid, may allow the head of the humerus to drop away from the glenoid cavity of the scapula for more than an inch. This condition, with the necessary prominence of the acromion, is apt at first sight to suggest the presence of a dislocation, or may, by the careless surgeon, be confounded with disease of the shoulder-joint, when such does not exist.

ARTERIES.

The cutaneous arteries of this region are derived from the *posterior circumflex, d*, the *dorsalis scapulæ, e*, the *posterior scapular, b, c*, and the *intercostal arteries, a*.

NERVES.

The arrangement of the cutaneous nerves is as follows:—Close to the spine appear a series of twigs derived from the *internal branches of the posterior primary divisions of the dorsal nerves, 2*. Of these the second is usually the longest. They run outwards over the back and shoulders. A cutaneous branch from the *circumflex, 3*, appears round the posterior border of the deltoid, and is distributed over the surface of this muscle. An *acromial branch of the cervical plexus, 1*, runs downwards over the upper border of the trapezius.

FIG. 2.

The dissection here shown was made from the same subject as that drawn in Fig. 1, but it has been represented upon a somewhat larger scale. In order to prepare it, the trapezius and deltoid were divided close to their attachments to the shoulder girdle, and after having been reflected were in part cut away. The edge of the latissimus was incised, and the muscle, thus freed, was allowed to fall downwards. All the parts thus exposed were next carefully cleaned, a small piece only of the fascia over the infra-spinatus being left *in situ*, in order to show the origin of the teres major. Lastly, the rhomboideus minor was divided and the ends were reflected so that the artery and nerve beneath it might be exposed.

MUSCLES.

The *rhomboideus minor*, M, arises from the spinous processes of the seventh cervical and the first dorsal vertebræ, and from the ligamentum nuchæ. Its fibres slope downwards and outwards, and the muscle is inserted on the posterior border of the scapula opposite the spine. It is crossed by the trapezius, and rests on the serratus posticus superior and the ribs. Its action is the same as that of the rhomboideus major.

The *rhomboideus major*, N, arises from a variable number of dorsal spines below the first, usually extending as far as the fifth. It is also attached to the supra-spinous ligaments. It is inserted on the posterior border of the scapula, between the spine and the angle. The muscle is in great part covered by the trapezius, and it rests upon the erector spinæ, the serratus posticus superior, a small piece of the origin of the splenius below the last muscle, and upon the ribs and intercostal muscles. The action is, like that of the rhomboideus minor, to impart a movement of rotation to the scapula, by means of which the inferior angle approaches the spine, while the glenoid cavity is tilted downwards. Both muscles help to raise the scapula, and in common with the serratus

magnus, keep the posterior border of the bone applied to the ribs, as is indicated by the fact that, if they be paralysed, this border of the bone forms a marked projection in the back.

The *supra-spinatus*, H, arises from all the supra-spinous fossa of the scapula, except near the neck of the bone, and also from the strong fascia which covers it. The fibres pass outwards beneath the acromion, and end in a tendon which blends with the capsule of the joint, and is attached to the uppermost of the impressions on the great tuberosity of the humerus. The muscle is covered by the trapezius and underlies the acromion process; it rests on the scapula, the shoulder-joint, and the supra-scapular vessels and nerves. Its action is to abduct the humerus; but one of its principal functions is to keep the head of the bone applied to the glenoid cavity of the scapula, and another to determine the rotation of the head of the humerus during abduction—i.e., to prevent the deltoid from simply pressing the head of the humerus against the glenoid cavity.

The *infra-spinatus*, G, was here, as is often the case, inseparably united with the *teres minor*. The dissection for the following Plate was made from the right arm of the same subject, and it will be seen that the two muscles were there perfectly distinct. The *infra-spinatus* arises from the infra-spinous fossa of the scapula, except opposite the neck of the bone and that part along the axillary border from which the *teres* muscles arise; it also takes origin from the strong fascia over it. The fibres end in a tendon which becomes closely united with that of the *supra-spinatus* and with the capsule of the shoulder-joint, and is inserted on the second of the three marks on the great tuberosity of the humerus. The muscle is partly subcutaneous, partly covered by the deltoid and the *latissimus dorsi* and the tendon of the trapezius. It rests on the scapula concealing the anastomosis of vessels on its dorsal aspect, and also covers part of the shoulder-joint. Its action is to rotate the humerus outwards.

The *teres minor*, Plate 44, Fig. 2, C, arises from the dorsal

aspect of the scapula along the axillary border, from a narrow surface which begins above at the impression for the long head of the triceps, and extends downwards as far as the surface from which the *teres major* arises; some fibres take origin from the fascia of the *infra-spinatus*. The muscle is inserted by means of a tendon which blends with that of the *infra-spinatus* and with the capsule of the shoulder-joint, to the lowest of the three marks on the great tuberosity of the humerus and for about an inch to the bone below. It is covered almost completely by the deltoid, but is also overlapped slightly by the *teres major*. It rests on the scapula, the long head of the triceps and the shoulder-joint. It acts as an external rotator and adductor of the humerus.

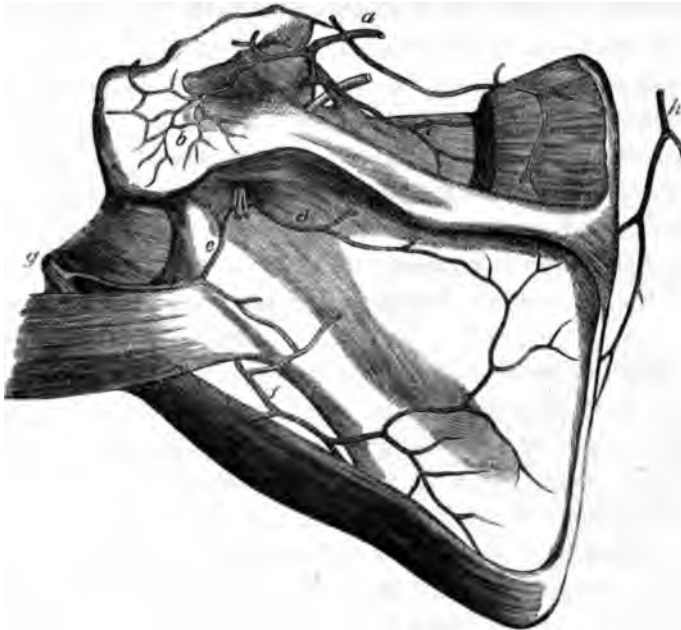
The *teres major*, E, will be described here; it is, however, better seen in the following, and in the preceding two Plates. It arises from a special mark on the dorsal aspect of the scapula, near the axillary border below the *infra-spinous* fossa, and below the attachment of the *teres minor*; many fibres arise also from the fascia over the *infra-spinatus*. The muscle ends in a tendon, seen in the dissection of the axilla, which passing to the front of the arm is inserted to the inner lip of the bicipital groove of the humerus.

The posterior aspect of the muscle is in part subcutaneous, and is in part covered by the *latissimus dorsi*, and the long head of the triceps; the anterior surface is in part applied to the *teres minor* and *infra-spinatus*, but the *latissimus dorsi* winds round the muscle so as to be in contact with its anterior as well as with its posterior surface and lower border; at the insertion, the anterior surface of the tendon is in contact with the axillary vessels and nerves. The *teres major* extends the humerus, and adducts the arm when it has been previously raised; it also acts as an internal rotator of this bone.

ARTERIES.

The *supra-scapular*, a, is here shown in its course behind the clavicle towards the supra-scapular notch, and its anastomosis, by

means of its *acromial branch, b*, with the acromio-thoracic; and by means of another branch with one derived from the *posterior scapular, f*. Another offset of the posterior scapular, *e*, is shown passing beneath the rhomboids; and the *superficial cervical, d*, appears beneath the trapezius. These arteries have been described at pp. 18–20. The anastomoses which they



Anastomosis of Vessels on Dorsum of Scapula.

a, Supra-scapular. *b*, Acromial Branch. *c*, Branch to Supra-spinous Fossa. *d*, Branch to Infra-spinous Fossa. *e*, Branch which Anastomoses with Posterior Circumflex. *f*, Dorsal Scapular. *g*, Posterior Circumflex. *h*, Posterior Scapular.

form with the *dorsal scapular, h*, a cutaneous twig of which artery is shown, may be observed in the accompanying wood-cut. In this specimen a considerable branch of the circumflex joined in this anastomosis.

NERVES.

An outer and back view of the *brachial plexus* is here obtained, with the *supra-scapular*, 2, and a root of the *nerve to the serratus*, 3. These nerves, as well as the *nerve to the rhomboids*, 6, 6', are described at pp. 53–56.

The lower end of the *spinal accessory*, 9, and its union with a branch from the cervical plexus, are also shown. (See p. 91.)

PLATE 44.

FIGS. 1 AND 2.

THIS dissection shows the superficial structures at the back of the arm. It was made by means of incisions which passed from the middle of the acromion to the external condyle of the humerus, and from a point a little behind the middle of the axillary border of the scapula to the internal condyle. The upper ends of these longitudinal incisions were joined by a straight cut, and the lower ends by one which passed below the elbow. After the cutaneous vessels and nerves had been dissected, the deep fascia was removed, and the muscles thus uncovered were cleaned.

The same subject was employed for the dissection shown in Fig. 2, but the incisions were extended slightly both above and below, and the forearm was turned up so as to give rather an external than a posterior view of the arm. After removing the superficial vessels and nerves, an incision at right angles to the direction of the fibres of the deltoid was made from the middle of its posterior border as far as the anterior incision in the skin; the muscle was then raised from the subjacent parts, some branches of artery and nerve entering it being necessarily divided. The external head of the triceps was next divided near its origin, and a considerable portion of this head was removed, without cutting the vessels and nerves entering it. The musculo-spiral nerve and the superior profunda artery, with their branches, were then cleaned. Lastly, the supinator longus was cut as low as possible, and after separating the brachialis anticus from the extensor carpi radialis longior, the lower ends of the musculo-spiral nerve and superior profunda artery were defined.

MUSCLES.

The only muscle in this Plate requiring description is the triceps; though the reader will not fail to notice the relations to it of the other muscles exposed. The quadrilateral and triangular spaces on the two sides of the upper end of the long head of the triceps are somewhat differently bounded when viewed from behind than when seen from in front, the upper boundary of each being formed by the teres minor instead of the subscapularis.

The *triceps* arises by three heads: the *long head*, Fig. 1, C, Fig. 2, G, has a tendinous origin, from the axillary border of the scapula, for about an inch, immediately below the glenoid cavity. The *outer head*, Fig. 1, B, Fig. 2, F, arises from the upper part of the posterior surface of the humerus by a fleshy and tendinous origin, from a quarter to half an inch wide, which extends from the lower part of the insertion of the teres minor to the musculo-spiral groove. The *inner head*, Fig. 1, D, Fig. 2, H (better shown in Plate 45, Fig. 1), has an extensive fleshy origin from the back of the humerus. This origin is triangular in shape, extending upwards as far as the lower part of the insertion of the teres major, and downwards to within one inch of the olecranon fossa. The inner side of the triangle is formed by the inner border of the shaft and the internal supra-condylar ridge; the outer, by a line passing down to the lower border of the musculo-spiral groove, and continued onwards by the external supra-condylar ridge; this head of the muscle also arises extensively from the back of both the internal and external intermuscular septa. The three heads join a strong tendon, which makes its appearance on the posterior surface of the muscle, about the middle of the arm. This tendon has a very characteristic shape at the upper part, shown in Fig. 1; below, it sends a very strong prolongation to the fascia at the back of the forearm, which has been removed in Fig. 2, in order to show the subjacent anconeus. The tendon is inserted on

the upper surface of the olecranon, except the extreme anterior part of this small surface, which is occupied by a minute bursa. The long head is covered on its posterior aspect by the deltoid and the teres minor, and the outer head is slightly overlapped by the deltoid; the remainder of the posterior surface of the muscle being subcutaneous. The opposite surface of the long head is in contact with the subscapularis and the teres major, and is overlapped by the inner head of the triceps below; while the rest of the muscle covers the bone, the intermuscular septa, the elbow-joint, and the musculo-spiral nerve and superior profunda artery.

The action of the triceps is to extend the elbow, but the long head adducts the humerus and draws it backwards.

ARTERIES.

The cutaneous arteries of this region are shown in Fig. 1. They are derived partly from the *posterior circumflex*, *a*; partly from the *posterior branch of the anastomotic*, *b*; and partly by *twigs from the axillary and the brachial arteries* which accompany the cutaneous nerves.

In Fig. 2 is shown the *superior profunda*, *c*, a branch of the brachial, which follows the same course as the musculo-spiral nerve, between the inner and outer heads of the triceps, and through the external intermuscular septum. It supplies muscular branches to the triceps and anconeus, and anastomoses below with the radial recurrent and the posterior interosseous recurrent, and with branches of the anastomotic. Cutaneous twigs accompany the external cutaneous branches of the musculo-spiral nerve. Some branches from the upper part of the artery anastomose with the posterior circumflex.

NERVES.

The *musculo-spiral*, Fig. 2, 5, is the largest nerve derived from the brachial plexus. It is, as it were, the continuation of the posterior cord, and lies at first behind the axillary and

brachial arteries. It then takes a spiral course round the humerus, in the interval between the inner and outer heads of the triceps, passing under cover of the long head, and occupying the musculo-spiral groove. On reaching the outer border of the humerus, the nerve perforates the upper part of the external intermuscular septum, and passes downwards between the supinator longus and the brachialis anticus to the front of the external condyle, where it ends by dividing into the radial and posterior interosseous nerves.

In the axilla, the musculo-spiral supplies the *internal cutaneous branch*, Fig. 1, 3, and Plate 45, Fig. 1, which comes off in common with one of the branches destined for the middle or the inner head of the triceps. This nerve is distributed to the inner and back part of the arm. The muscular nerves to the inner and long heads of the triceps, which are given off from the musculo-spiral before it enters the musculo-spiral groove, are shown in Plate 45, Fig. 1. One of them (to the inner head) closely accompanies the ulnar nerve. In the groove, muscular branches are given off to the *outer*, 6, and to the *inner*, 9, heads of the triceps, and to the anconeus, as well as the two *external cutaneous nerves*. The nerve to the anconeus runs downwards in the substance of the triceps, to reach the muscle to which it is distributed, in company with a branch of artery. The external cutaneous nerves leave the trunk in common with some of the muscular branches; one pierces the fascia of the arm at a higher level than the other, and rather anterior to it, and is distributed to the skin of the outer part of the arm; the inferior branch passes behind the elbow to the back of the outer side of the forearm, reaching down to the wrist, and joining with branches of the musculo-cutaneous. After perforating the intermuscular septum, the musculo-spiral gives off muscular branches to the *brachialis anticus*, 10, 10, the *supinator longus*, 11, 11, and to the *extensor carpi radialis longior*, 12.

In making incisions in the back or outer part of the arm,

the surgeon must carefully bear in mind the position of the musculo-spiral nerve; it is, perhaps, in operations about the outer condyle that it is specially liable to injury. The musculo-spiral is very likely to be damaged by the pressure of the top of a crutch, at the part where it is turning from the axilla to the back of the arm; it is thus no uncommon phenomenon to find musculo-spiral palsy following a fracture of the leg.

The *circumflex nerve*, 1, is here shown with the accompanying artery, almost in its natural position. The branch to the *teres minor*, 4, with the gangliiform swelling upon it, is now seen for the first time, although it has been previously described.

PLATE 45.

FIG. 1.

THE dissection, from which this drawing was taken, shows the superficial muscles, vessels, and nerves of the fore and inner part of the arm. It was made by the following incisions:— One passed from the tip of the acromion process to the outer border of the forearm two inches below the bend of the elbow; another from the middle of the posterior fold of the axilla to a little behind, and two inches below, the inner condyle. These incisions were joined below by one made transversely across the front of the forearm, and above by one which was directed first from the posterior to the middle of the anterior fold of the axilla, and then straight across the pectoralis major to the acromion. The cutaneous vessels and nerves were first dissected, and their position accurately noted. The deep fascia was then taken away and the parts beneath were cleaned. The fat was cleared away from the outer part of the axilla sufficiently to expose the subscapular vessels.

The *fascia of the arm* is for the most part thin, but is strengthened at the elbow by a strong piece derived from the tendon of the biceps, the bicipital fascia, which, however, belongs more to the fascia of the forearm than to that of the arm. Above, the fascia is continuous with that of the axilla (p. 368). Two stout intermuscular septa separate the triceps from the muscles on the front of the arm, and are attached to the supra-condylar ridges on the humerus. The *inner* (Fig. 2, ¶) gives origin behind to the triceps, and in front to the brachialis anticus; the *outer* (Plate 44, Fig. 2) gives origin behind to the triceps, and in front to the supinator longus and extensor carpi radialis longior, as well as to the brachialis anticus.

MUSCLES.

A better view is given in this Plate of the *inner head of the triceps*, H, than in any of the foregoing ones; the *long head*, J, of the same muscle is also shewn under a fresh aspect (*Vide* p. 392).

The only muscle requiring description is the *biceps*, F, for the origins and insertion of which the reader is referred to Fig. 2 of this Plate. It arises by two heads, one, the long head, Fig. 2, G, being attached within the capsule of the shoulder-joint to the upper part of the glenoid cavity of the scapula and the glenoid ligament; the other, the short head, Fig. 2, F, springing with the coraco-brachialis from the tip of the coracoid process. The long head is surrounded by a prolongation of the synovial membrane of the shoulder-joint, as it lies in the bicipital groove. The two heads, which are at first tendinous, become muscular as they emerge from beneath the pectoralis major and meet in the upper third of the arm to form the large fleshy belly of the muscle, which gives the characteristic shape to the front of the arm. Just above the bend of the elbow, this gives place to the lower tendon, which is broad at first, but narrower and thicker below, and which passes downwards and backwards to be inserted on the posterior part of the tubercle of the radius. From the inner side of this lower tendon is given off a strong fibrous expansion, which crosses the brachial vessels, passing obliquely downwards and inwards and is continuous with the fascia of the forearm.

The muscle is subcutaneous, except above, where its two heads are covered by the pectoralis major and deltoid, and below, where its tendon dips into the triangular space at the bend of the elbow, and is crossed by the radial artery and overlapped by the supinator longus. It rests upon the brachialis anticus and the humerus. Its inner border corresponds to, and in the middle of the arm overlaps, the brachial artery. The action of the biceps is to flex the elbow and to

supinate the forearm. The long head has a feeble power of abducting, and the short head of flexing, the shoulder.

ARTERIES.

The *brachial*, *b*, may be studied in both figures of this Plate. In the first, the connections of the vessel are shown ; in the second, the branches, so far as they can be seen from the inner side of the limb. The artery begins at the lower border of the *teres major*, and ends opposite the neck of the *radius* by dividing into the *radial* and *ulnar*, its direction being indicated on the surface of the body by a line drawn from the inner border of the *coraco-brachialis* to a point an inch below the middle of the bend of the elbow. The inner border of the *biceps* may thus be taken as a guide to the position of the artery, which is slightly overlapped by the belly of the muscle, and is covered at its lower part by the *bicipital fascia*. The *internal cutaneous nerve* lies on the artery in the upper half of the arm, and the *median nerve* crosses it about the middle. The *median basilic vein* crosses it just above the bend of the elbow. The *brachial artery* rests on the long and inner heads of the *triceps*, the insertion of the *coraco-brachialis*, and the *brachialis anticus*. The *musculo-spiral nerve* lies behind the upper part of the artery, and the *median* occasionally crosses beneath instead of in front of it. To the inner side, are the *basilic vein* and the *ulnar nerve* above, and the *median nerve* and a *vena comes* below ; to the outer side are the *coraco-brachialis* and *biceps* muscles, a *vena comes* throughout its whole length, and the *median nerve* in the upper half of its extent.

From the outer side of the artery are given off a number of branches which supply the muscles of this region, and also a nutrient vessel, which arises below the insertion of the *coraco-brachialis*, and has a downward direction. From the inner side spring the following named branches :—

The *superior profunda*, not seen in either of these drawings, but shown in Plate 44, and described at p. 393. It accompanies the musculo-spiral nerve.

Inferior profunda, Fig. 1, *d*, Fig. 2, *k*, leaves the brachial near the insertion of the coraco-brachialis, and takes the same course as the ulnar nerve, running down to the interval between the internal condyle and the olecranon, where it anastomoses with the anastomotic and the posterior ulnar recurrent.

The *anastomotic*, Fig. 1, *e*, Fig. 2, *l*, arises at a lower level than the inferior profunda, but takes a similar direction, passing over the brachialis anticus, and through the internal intermuscular septum and the fibres of the triceps, to the interval between the inner condyle and the olecranon. It supplies an anterior branch, Fig. 2, *m*, which often, as was the case in this arm, comes off independently. This anterior branch passes down beneath the pronator radii teres, and anastomoses with the anterior ulnar recurrent. The anastomotic also sends a transverse branch outwards across the back of the humerus, which anastomoses with the posterior branch of the superior profunda.

Ligature of the brachial may be easily performed in any part of its course; but the points usually selected are in the middle of the arm, or just above the bend of the elbow. In the former case, an incision two or three inches long is made along the edge of the biceps through the skin and the superficial and deep fasciæ; when the edge of the biceps is reached, this muscle is pulled outwards, and the artery is carefully separated from the surrounding veins and the median nerve. If tied in the lower part, a somewhat shorter incision is made parallel to but slightly above the median basilic vein, which must not extend further than the tendon of the biceps. This incision is made through the subcutaneous fat, and if prolonged may divide the median cephalic vein. After pulling the median basilic vein downwards the bicipital fascia is divided, and the

artery is found in the middle of the incision, with a vein on each side and the median nerve to its inner side.

VEINS.

The superficial veins at the bend of the elbow are described in connection with the following Plate. It may be observed that the *median basilic*, β , is crossing the brachial artery at one of the spots usually selected for ligature. The *basilic*, δ , lies to the inner side of the artery, and conceals the inner *vena comes*, which vein it joins at a variable level, sometimes in the axillary space, to form the axillary trunk. The outer *vena comes* is indicated near the elbow, and often enters the axillary near the apex of the axilla. Transverse branches of various sizes connect the venæ comites across the brachial artery. The *cephalic*, γ , is shown in the interval between the deltoid, and the pectoralis major. It is seen at the upper part to pass deeply between these muscles.

Venesection is most commonly practised upon the median basilic vein, as this is usually of larger size than the median cephalic, but if the latter be the larger, it should be selected by preference. A bandage being loosely applied above the elbow to obstruct the venous, but not the arterial, circulation, the thumb is placed on the vein below the point at which the incision is to be made, and the lancet is plunged with a single thrust through skin and superficial fascia into the vein. The finger being then removed, the blood is allowed to flow into the bleeding-cup, while the patient is made to grasp a rod of some kind, in order to force the blood upwards from the deep veins of the forearm, by means of the muscular contractions. When sufficient has been drawn, the bleeding is easily arrested by means of a pad and bandage. In the days when phlebotomy was common and often practised by the inexperienced, it was no rare accident for the lancet to pierce not only the vein, but the bicipital fascia, and occasionally the brachial artery. After such a mishap, a communication between

the artery and vein resulted, causing either the formation of a venous aneurism or an aneurismal varix. The latter consists of a pulsating varicosity of the veins of the arm and forearm; the former, of an aneurismal sac communicating both with the vein and the artery. Either condition is a source of great inconvenience to the patient, besides causing considerable interference with the general circulation of the limb. Such a condition is, at the present day, rare in any situation.

NERVES.

The cutaneous nerves of the inner and anterior part of the arm are supplied by the internal cutaneous, the nerve of Wrisberg, the internal cutaneous branch of the musculo-spiral, and the intercosto-humeral.

The *internal cutaneous*, 2, lies at first in front of the brachial artery. About the middle of the arm, it bifurcates and perforates the deep fascia, either before or after dividing. The anterior division again subdivides, and passes down in front of the elbow to supply the skin of the front and inner part of the forearm, some branches being superficial to, and some beneath, the median basilic vein. The posterior division, 3, passes backwards, and supplies the inner and back part of the forearm; it joins the nerve of Wrisberg.

The *nerve of Wrisberg*, 4, here of large size, is derived from the inner cord of the brachial plexus. It passes to the back of the elbow, often, as in this case, taking in great part the place of the posterior branch of the internal cutaneous, which nerve it usually joins.

The *intercosto-humeral*, 8, the lateral branch of the second intercostal nerve, also varies considerably in size; it supplies the area of skin above and behind that to which the nerve of Wrisberg is distributed, and reaches the back of the arm, Plate 44, Fig. 1.

The *internal cutaneous of the musculo-spiral*, 7, comes off

in common with the branch to the inner, or that to the long, head of the triceps, and supplies the skin of the arm, behind the part to which the intercosto-humeral is distributed. It also reaches the back of the arm, Plate 44, Fig. 1.

The nerve to the *inner head of the triceps*, 6, closely accompanies the ulnar nerve. In this subject, a small twig derived from it, 11, joined the posterior branch of the internal cutaneous. This is, however, not usual.

The *median*, 1, lies at first to the outer side of the brachial artery; it crosses this vessel about the middle of the arm, and in the lower part lies to its inner side, while still retaining a close relation with the artery. It gives no branch in the arm, but is frequently united by a cross branch of greater or smaller size with the musculo-cutaneous.

The *ulnar*, 5, lies in the upper third of the arm to the inner side of, and in close contact with, the brachial artery. It then leaves the artery and passes to the interval between the inner condyle and the olecranon. In the lower part of its course, it may sometimes pierce the inner intermuscular septum, though it usually passes backwards above this structure. The nerve lies at last in the fibres of the triceps, for a longer or shorter distance. No branches are given off in the arm. It is accompanied by the inferior profunda artery.

FIG. 2.

This dissection was made from the last by extending the cutaneous incisions upwards so as to reach the coracoid process, and downwards so as to extend below the triangular hollow in front of the bend of the elbow. The cutaneous vessels and nerves were all cut short. The pectoralis major was divided, and its ends turned inwards and outwards. Some of the anterior fibres of the deltoid were divided, so as to allow of this muscle being turned out over the shoulder.

The biceps was then cut through just below the point at which the two heads of origin meet, and also at the commencement of the tendon of insertion; the intervening part was taken away, after dividing the vessels and nerves which entered its deep surface. The parts thus exposed were next cleaned, and all the veins, except a part of the axillary, were removed. The muscles surrounding the triangular space at the bend of the elbow were drawn aside, in order to gain access to this cavity, and take away the fat contained in it.

The limb is shewn more from the anterior aspect in this drawing than in Figure 1.

MUSCLES.

The *coraco-brachialis*, E, arises from the tip of the coracoid process and from the inner side of the tendon of the short head of the biceps. It forms a roundish, fleshy belly, which passes vertically downwards to be inserted on the inner border of the humerus about the middle of the bone. The muscle is partly subcutaneous, but is partly covered by the deltoid and pectoralis major above, and is overlapped by the biceps below. It rests upon the subscapularis and the humerus, and the insertion of the latissimus dorsi and teres major. The axillary and brachial vessels and the median nerve are in contact with its inner border, and the musculo-cutaneous nerve perforates it. At its origin, it is firmly connected by fascia with the insertion of the pectoralis minor. It is a flexor and adductor of the shoulder—that is, it brings the arm forwards, upwards, and inwards.

The *brachialis anticus*, M, arises from the front of the lower part of the humerus—namely, from the lower halves of both the internal and external surfaces. It also arises slightly from the upper part of the external intermuscular septum, and considerably from the inner septum. Often, as in this instance, it is attached to this structure only near the humerus, but

sometimes the fibres spring from the whole of its anterior surface. The upper end of the muscular origin is bifid, one piece passing between the coraco-brachialis and the insertion of the deltoid, and the other external to the deltoid. At the lower part, a strong tendon appears on the middle of the anterior aspect of the muscle; but at the sides the fleshy fibres continue almost to the insertion; which takes place on the anterior aspect of the coronoid process of the ulna. The muscle rests upon the humerus and the elbow-joint. It is covered in part by the biceps, and is overlapped below by the muscles bounding the triangular space at the bend of the elbow. The brachial vessels, and the median, the musculo-cutaneous, and musculo-spiral nerves are also in contact with its anterior surface.

It is a simple flexor of the elbow.

ARTERIES.

It is only necessary to observe that the bifurcation of the brachial artery is here seen, and that many of its muscular branches are now dissected.

The *anterior circumflex*, *h*, from the axillary, is better shown than has been the case in previous Plates.

NERVES.

The *musculo-cutaneous*, 4, 4, springs from the outer cord of the brachial plexus, and enters, almost immediately after its origin, the fibres of the coraco-brachialis. As it pierces the muscle, it gives a branch to supply it, and after emerging on its anterior surface, pursues its course down the arm, between the brachialis anticus and the biceps, giving twigs to these muscles, 5, 5'. The nerve becomes superficial between the tendon of the biceps and the supinator longus, and perforating the deep fascia at the bend of the elbow, furnishes numerous

branches to the cutaneous structures at the outer part of the forearm, of which it supplies both the anterior and posterior aspects. These branches join with the radial and with one of the external cutaneous branches of the musculo-spiral, and some reach as far as the front of the ball of the thumb. (Plate 46, Fig. 1.)

PLATE 46.

FIG. 1.

THE dissection for this drawing was made by means of the following incisions. One was carried across the front of the arm, two inches above the elbow. From the extremities of this incision, others were made along the inner and outer borders of the forearm and hand, one reaching to the root of the thumb, and one to the root of the little finger. These vertical cuts were joined below, by one which passed across the web of the fingers, and lastly the skin was removed from the front of the thumb and of the middle and ring fingers. In the forearm, the cutaneous vessels and nerves were dissected; and after making a plan of these, the deep fascia was exposed and removed. The superficial veins are only represented in the upper part of the drawing. In the hand, the cutaneous vessels and nerves and the palmar fascia are shown; but in the case of the ring finger, the vessels and nerves were taken away in order fully to expose the sheath of the tendon. It is thus of course evident that the dissection is carried a stage deeper in the forearm than in the hand.

The *palmar fascia* is that which covers and holds down the various structures occupying the palm. It is naturally divided into three portions:—two *lateral*, **, an inner and an outer, which lie upon the short muscles of the thumb and little finger, and are thin and insignificant; and a *central portion**, occupying the middle of the palm and constituting the palmar fascia proper. This latter is a strong white fascia, triangular in shape, with the apex directed upwards where it

is closely adherent to the anterior annular ligament, and is continuous with the tendon of the palmaris longus, or blends with the deep fascia of the front of the forearm if this muscle be absent. From the upper part, the fibres radiate downwards, and ultimately divide into four slips which are continued on to the anterior surface of the sheaths of the flexor tendons of the fingers. The fascia becomes thinner towards the lower part of the palm, and throughout its lower half it is strengthened by scattered *bands of transverse fibres*, ○. Close to the root of the fingers is a superficial band of transverse fibres, mixed with a good deal of fat and closely connected with the superficial fascia, to which has been given the name of *superficial transverse ligament*, ||. On each side of the flexor tendons, near the clefts of the fingers, processes of fascia pass in deeply, to be attached to the anterior surface of the deep transverse ligament. These deep prolongations may be demonstrated, by making a longitudinal incision over the flexor tendons opposite one of the metacarpophalangeal joints; they will thus be seen to form part of the lateral boundary of the sheath, which by such an incision would have been opened. Laterally, the fascia is partly continuous with the septum between the long flexor tendons and the short muscles of the thumb and little finger, while in part it loses itself in the subcutaneous fat. The palmar fascia varies considerably in thickness in different subjects. It is closely adherent to the subcutaneous fat, through which it sends numerous and rather strong fibrous prolongations into the skin. It is perforated by numerous cutaneous branches of vessels and nerves.

Beneath the central part of the fascia, pus may accumulate as the result of a punctured wound in this situation, or from the burrowing upwards of an abscess originating in the fingers. Such a collection of pus requires free and immediate evacuation, not only on account of the obstruction to its exit which the fascia opposes, but also from the large amount of mischief

which may arise from the presence of matter amongst the deeper structures of the palm. At the same time, the surgeon must bear in mind the position of the not inconsiderable arterial and nervous trunks which lie immediately beneath the fascia. Great difficulty is often found in securing a bleeding point beneath the fascia, necessitating either an extensive enlargement of the incision, or the plugging of the wound, with the disastrous results which frequently follow the latter proceeding.

A not uncommon condition, especially in persons of a gouty habit, consists in the gradual development of a contraction of some part of the palmar fascia. This most often affects, in the first place, the fascia over the ring finger, but may extend to other parts. It may be cured, or at least temporarily relieved, by subcutaneous division, at several points, with a tenotomy knife.

MUSCLES.

The *palmaris brevis*, M, is a small cutaneous muscle of quadrilateral shape, lying over the upper part of the hypothenar eminence. It arises from the palmar fascia, a little to the inner side of the middle line of the palm; and is inserted into the skin at the inner border of the hand. This muscle can only with difficulty be brought into action alone. Its function appears to be to pucker the skin at the inner part of the hand, and to assist in forming a cup or hollow of the palm.

Of the muscles of the forearm, four only are now seen at all completely; but the flexor sublimis digitorum and the flexor longus pollicis are partly uncovered, and a little dissection serves to show the outer part of the pronator quadratus, without disturbing the other muscles.

The *supinator longus*, H, belongs rather to the muscles of the back of the forearm. It arises from the upper two-thirds of the external supra-condylar ridge and from a corresponding part of the anterior surface of the external intermuscular

septum of the arm. It is a flattened and somewhat twisted muscle, ending in a tendon in the lower third of the forearm, which is inserted on the outer surface of the radius just above the styloid process of this bone. Its two surfaces look at first forwards and backwards, and are in contact respectively with the brachialis anticus and the triceps, the intermuscular septum intervening between it and the latter muscle. In the forearm these surfaces are directed inwards and outwards, the latter being subcutaneous, except at the lower end, where it is covered by the tendons of the extensor ossis metacarpi and of the extensor primi internodii pollicis; while the former surface rests upon the supinator brevis, the pronator teres, the flexor sublimis digitorum, the flexor longus pollicis, the radial extensors of the wrist, the musculo-spiral nerve and its two terminal divisions, and the radial vessels. The supinator longus is a flexor of the elbow, and brings the forearm into the mid-position between supination and pronation.

The *flexor carpi radialis*, B, arises from the internal condyle of the humerus by an origin common to it and several other muscles of the forearm, and also from the fascia of the forearm, and the intermuscular septa. The origin from fascia is generally more extensive than that from bone. Below the middle of the forearm, the muscle ends in a strong tendon, which enters the groove on the os trapezium, lying therefore between the two attachments of the anterior annular ligament to this bone, and is inserted on the anterior surface of the base of the metacarpal bone of the index finger. The flexor carpi radialis is subcutaneous except at the lower part, where it passes deeply under the annular ligament. Above, it lies between the pronator radii teres and the palmaris longus; below, between the latter muscle and the supinator longus. It rests principally upon the flexor sublimis digitorum, but its tendon lies over that of the flexor longus pollicis. Its action is to

flex the wrist and the elbow, and to abduct the hand while it is also a weak pronator. The palmar part of the muscle is shown in Plate 47, Fig. 1.

The *palmaris longus*, C, the smallest muscle of the superficial layer in the forearm, arises by the common origin from the internal condyle of the humerus, from the fascia of the forearm and from the intermuscular septa. It ends below the middle of the forearm in a narrow tendon which is inserted into the palmar fascia, the central part of which appears to be an expansion of this tendon. The tendon also usually sends a prolongation from its outer side to join the origin of the abductor pollicis (Fig. 2, H). The muscle is subcutaneous, and rests on the flexor sublimis digitorum. Above, it lies between the flexor carpi radialis, and the flexor carpi ulnaris; below, between the flexor carpi radialis, and a part of the flexor sublimis digitorum. It acts as a flexor of the wrist and elbow, and it makes tight the palmar fascia.

The *flexor carpi ulnaris*, D, arises from the inner condyle by the common origin, from the fascia of the forearm and the intermuscular septum, as well as from the inner border of the olecranon, and the posterior border of the shaft of the ulna for about two-thirds of its length. Muscular fibres extend as far as the wrist, but a strong tendon appears on the front of the muscle, which is inserted into the pisiform bone. The flexor carpi ulnaris is flattened, and its surfaces look inwards and outwards; it is subcutaneous throughout its extent, and rests upon the flexor profundus digitorum, and the ulnar vessels and nerve; the latter passing into the forearm beneath a small tendinous arch which intervenes between the attachments of the muscle to the internal condyle and the olecranon. It acts as a flexor of the wrist and an adductor of the hand; and, by drawing up the pisiform bone, gives a fixed point from which the abductor minimi digiti may act.

ARTERIES.

The *brachial artery*, *a*, lies just internal to the tendon of the biceps in the hollow in front of the bend of the elbow. The *radial artery*, *b*, is seen in the lower part of the forearm between the tendon of the flexor carpi radialis and that of the supinator longus. The *ulnar artery* is generally slightly exposed at the outer side of the tendon of the flexor carpi ulnaris, near the wrist. The cutaneous arteries of the forearm are derived from these two trunks. In the hand the digital branches are seen running along the fingers, and small cutaneous twigs derived from them, supply the palm of the hand.

VEINS.

The superficial veins of the forearm are subject to considerable variation; for the sake of clearness, they have been removed at the lower part of the dissection. The *median vein*, *a*, begins by small radicles at the front of the wrist, or by branches from the outer side of the hand. Below the bend of the elbow, this vein is joined by a *deep branch*, β , derived from the *venæ comites* of the ulnar artery, and then splits into two parts, the *median basilic*, δ , and the *median cephalic*, γ , which passing obliquely inwards and outwards as well as upwards, are joined respectively by the *ulnar*, η , and the *radial*, ϵ , veins. The ulnar veins are two in number, anterior and posterior; they begin by tributaries at the inner part of the hand, and running up one in front, and one behind the inner border of the forearm they join, either separately or together, the median basilic vein, to form the basilic trunk. The radial vein begins at the back of the thumb and the radial side of the back of the hand, and passing up the outer border of the forearm, joins the median cephalic, to form the cephalic vein. The course of the basilic and cephalic veins, and the rela-

tion of the median basilic to the brachial artery have been referred to at p. 400.

Along the front of the forearm, and for the most part in company with the veins, are found numerous lymphatic vessels.

NERVES.

The cutaneous nerves of the front of the forearm are derived, on the inner side from the *internal cutaneous*, 7, 7, and on the outer side from the *musculo-cutaneous*, 9. Small palmar branches are supplied by the median and the ulnar nerves, which will be described when these nerves are reached. The digital nerves are found at the sides of the fingers, and small cutaneous twigs derived from them are seen in the palm. The *radial nerve*, 10, is shown as it is passing from beneath the tendon of the supinator longus to the back of the hand; the *median nerve* appears at the upper part of the dissection in the hollow at the bend of the elbow, and at the lower part, in the interval between the tendons of the flexor carpi radialis and the palmaris longus, or sometimes beneath the latter muscle.

FIG. 2.

This drawing represents a deeper stage of the dissection of the forearm. It was made from one carried to the same depth as that shown in Fig. 1, by the partial removal, one after the other, of the supinator longus, the flexor carpi radialis, and the palmaris longus; and by cleaning the structures thus exposed. In the hand, the palmar fascia and the palmaris brevis were removed, and the skin and subcutaneous structures were taken from the little finger so as to expose the sheath of the tendons; while in the ring finger the sheath was opened and the tendons were displaced slightly inwards. The veins were all removed.

MUSCLES.

The *pronator radii teres*, F, arises from the lower part of the inner supracondylar ridge, from the inner condyle of the humerus by the common tendon, from the deep fascia of the forearm, and from the intermuscular septum on the inner side between it and the neighbouring muscles. There is also a separate tendinous slip of origin from the inner side of the coronoid process of the ulna, Fig. 3, F'. The fibres of the muscle are directed across the limb, obliquely downwards and outwards towards the insertion, which takes place by tendinous fibres on a special rough impression on the outer surface of the radius, about the middle of the bone. The muscle is subcutaneous, except near its insertion, where it is overlapped by the supinator longus and by the radial extensors of the wrist. It rests upon the brachialis anticus, the supinator brevis, the flexor sublimis digitorum, the ulnar artery, and the median nerve. The median nerve passes between the two heads of origin, while the ulnar artery is beneath the deep head. The pronator radii teres is a flexor of the elbow, and a strong pronator of the forearm.

The *flexor sublimis digitorum*, J, J, is a large muscle which arises from the inner condyle of the humerus by means of the common tendon, from the internal lateral ligament of the elbow joint, from the inner border of the coronoid process*, from the oblique line of the radius, and for a variable distance, from the anterior border of the radius about the middle of the bone. The muscle, which is deeply subdivided into its component parts, ends in four tendons which pass beneath the annular ligament and then are directed to the four fingers. After entering the palm, each tendon lies immediately over the corresponding one of the deep flexor; and opposite the

* By a tendinous band internal to the origin of the pronator radii teres, but usually united with the long origin of the flexor longus pollicis.

first phalanx it splits into two parts in order to allow the passage of the latter tendon. These two parts are blended together over the second phalanx, and again separating are inserted on the sides of the base of the second phalanx. It may be noted that the part of the muscle which belongs to the middle finger is broad and flat, and is the only part attached to the radius. Above the annular ligament, the tendons of the middle and ring finger are superficial to those of the index and little finger. The tendons of the short and of the long flexor, in each finger, are included in a sheath which is strengthened by fibres prolonged from the palmar fascia, and is attached to the margins of the anterior surfaces of the phalanges and to the sides of the capsules of the joints. Opposite the joints, the sheath is thin, and is marked by fibres crossing obliquely; opposite the phalanges is a strong fibrous ring (*ligamentum vaginale*), somewhat distinct from the rest of the sheath, and binding the tendon down firmly to the bone. This arrangement is shown in the ring finger of Fig. 1, and in the little finger of Fig. 2. If the sheath be opened, as in the ring finger of Fig. 2, it is found to be lined by a synovial membrane, which is reflected on to the tendons at the posterior part near the insertion of each, forming folds, to which the term *ligamenta brevia* is applied* (see Plate 47, Fig. 1, middle finger); while from the parietal to the visceral layer extend delicate bands of synovial membrane called *ligamenta longa*, +. This synovial sheath, as shown in the drawing, extends about one-and-a-half inch above the web of the fingers. A similar sheath surrounds the tendon of the flexor longus pollicis and extends one inch above the annular ligament. Beneath the

* These are described in a Paper by Mr. Marshall in the *British and Foreign Medico-Chirurgical Review*, June, 1853. The term *vincula vasculosa* was applied to all these folds of synovial membrane, and that of *ligamenta subtila* to certain bands of elastic fibres, which exist in the *ligamenta brevia*.

annular ligament is a loose synovial sheath, which occupies the interval between the tendons of the superficial and deep flexors, and that between the deep flexor tendons and the wrist-joint. This extends upwards a very short distance above the annular ligament, and downwards almost, if not quite, as far as the commencement of the sheaths of the fingers. It communicates directly with the sheath of the little finger, and often, but not always, by a small opening with that of the flexor longus pollicis, where the two are contiguous. These communications are of interest, and may be of importance, in connection with whitlow; suppuration in the sheath of the thumb or little finger, being more likely to affect the common sheath under the annular ligament, than is the same condition in the other fingers. I have, however, more than once seen effusion into the sheath of the flexor longus pollicis which did not involve the common sheath, indicating that the communication either did not exist or had become closed.

The flexor sublimis is covered by the flexor carpi radialis, the palmaris longus, the pronator radii teres, the supinator longus, and the annular ligament; a narrow strip of the muscle is subcutaneous almost as high as the condyle; this subcutaneous part becomes wider below, and is crossed by the radial vessels. The muscle rests upon the flexor profundus digitorum, the flexor longus pollicis, the ulnar vessels and the median nerve. The flexor sublimis acts as a flexor of the first interphalangeal, and of the metacarpophalangeal joints, and of the wrist; it also feebly bends the elbow.

The short muscles of the thumb will be discussed in connection with Fig. 3.

ARTERIES.

The *radial, c*, begins at the bifurcation of the brachial, *a*, about an inch below the middle of the bend of the elbow,

and is directed, nearly in a straight line, from this point to one situated opposite the lower end of the radius, between the tendons of the supinator longus and the flexor carpi radialis, but somewhat nearer to the latter; beyond this point it turns backwards to the dorsum of the hand, where it will be met with afterwards. In the part of its course which is now exposed, the artery is subcutaneous below, but above, is overlapped by the belly of the supinator longus; it rests in succession on the tendon of the biceps, on the supinator brevis, the pronator radii teres, the flexor sublimis digitorum, the flexor longus pollicis, a small piece of the insertion of the pronator quadratus (a considerable amount of fascia intervening), and on the lower end of the radius. The vessel is surrounded by venæ comites, and the radial nerve approaches, and sometimes touches it, in the middle third of the forearm.

Ligature of the radial is usually practised near the wrist: an incision two inches or less in length over the course of the vessel through skin and fasciæ leads to it at once; the needle may be passed from either side. No difficulty attends the application of the ligature at a higher point; but if it be practised near the commencement of the vessel, the edge of the supinator longus must be pulled outwards.

The branches of this part of the radial are as follows:—*muscular* to the surrounding muscles; *cutaneous* to the outer part of the front of the forearm; the *radial recurrent, d*, which leaves the commencement of the artery and running upwards over the supinator brevis, anastomoses with the superior profunda between the supinator longus and the brachialis anticus; the *anterior carpal, f*, arises just above the wrist, and runs inwards below the pronator quadratus to join a corresponding branch of the ulnar, which will appear in a deeper dissection; the *superficial volar, e*, leaves the radial at the lower part, and passing downwards either over or through the muscles of the

thumb, to which, as well as the skin, it supplies branches, ends by joining the superficial palmar arch.

Some branches of the radial to the thumb and index finger are shown in this dissection, but they will more conveniently be considered in connection with the following Plate. The description of the ulnar artery and its branches, will be given in connection with Fig. 3.

NERVES.

The *radial*, 10, begins at the bifurcation of the musculo-spiral, in front of the external condyle of the humerus. It passes down the forearm, along the edge of the extensor carpi radialis longior, under cover of the supinator longus. It approaches, or may lie in contact with the radial artery in the middle of the forearm, but leaves it below this level to pass beneath the tendon of the supinator longus to the back of the forearm, where it will be subsequently met with. In the front of the forearm, it supplies no branches, unless that to the short radial extensor of the wrist arise from it instead of from the posterior interosseous.

FIG. 3.

This drawing represents a deeper dissection of the forearm than that shown in Fig. 2, from which it was prepared in the following way :—The radial artery, the superficial palmar arch, and the digital nerves and vessels were taken away, after removing the skin from the index finger. The sheaths of the tendons were then opened, the annular ligament was divided, and the flexor sublimis digitorum, with the exception of a small piece of its origin and the four tendons of insertion, was taken away. The pronator radii teres and the abductor pollicis were also in great part removed.

MUSCLES.

The *flexor profundus digitorum*, M, arises from the anterior and inner surfaces of the ulna, below the insertion of the brachialis anticus, and above the origin of the pronator quadratus, and also from the interosseous membrane for a corresponding extent. Above the annular ligament, the muscle usually consists of two tendons, one broad and internal, more or less subdivided and destined for the three inner-fingers, and another external, for the index finger; this latter piece, indeed, forms almost a separate muscle. Below the annular ligament, four tendons are found, which in their course downwards become superficial by passing between the two pieces into which the tendon of the superficial flexor divides (vide p. 413), and are inserted into the anterior surfaces of the bases of the terminal phalanges of the fingers. The muscle is completely covered by the flexor sublimis digitorum and the flexor carpi ulnaris, except at the tips of the fingers; it is crossed by the ulnar origin of the flexor longus pollicis, and by the ulnar vessels and nerve. It rests on the ulna and the interosseous membrane, on the pronator quadratus, and the deep structures in the palm. The flexor longus pollicis lies along its outer border, and the lumbricales arise from the tendons in the palm. The synovial sheaths are described at p. 414. The flexor profundus flexes the terminal joints of the fingers, after the first interphalangeal joints have been bent by the superficial flexor. It will also flex the other joints of the fingers and the wrist.

The *flexor longus pollicis*, L, L, arises from the anterior surface of the radius, between the insertions of the supinator brevis and the pronator quadratus, and from the interosseous membrane for a corresponding extent. It also arises from the inner side of the coronoid process, by a long slender head which usually is combined with the coronoid origin of the flexor sublimis digitorum. The muscle ends in a tendon which

passes beneath the annular ligament, to be inserted into the anterior surface of the base of the terminal phalanx of the thumb. The belly of the muscle is partly covered by the flexor sublimis digitorum, the flexor carpi radialis, and the radial vessels, but is partly subcutaneous; it rests upon the radius, the interosseous membrane and the pronator quadratus, and is in contact, on the inner side, with the anterior interosseous vessels and nerve and with the flexor profundus digitorum. The tendon, after passing beneath the anterior annular ligament, lies between the two heads of the flexor brevis pollicis, as far as the first phalanx, and afterwards is superficial. The flexor longus pollicis flexes all the joints of the thumb, and also the wrist joint.

The *lumbricales*, X, X, X, X, are four small muscles which arise from the tendons of the flexor profundus digitorum, the two outermost being usually attached to single tendons, the others to two tendons each. Each muscle has a small rounded belly, and ends in a minute tendon, which blends with the expansion formed by the tendons of the extensor communis digitorum on the back of the first phalanx. These muscles are usually inserted on the outer side of the fingers to which they respectively belong; but I have here illustrated a very common arrangement, in which two muscles go to the middle finger, while the ring finger receives none at all. Other variations frequently occur. The action of the lumbricales is to flex the metacarpo-phalangeal, and to extend the inter-phalangeal, joints. This movement, which is common to the lumbricales and the interossei, is performed in making the upstroke in writing. Any power of moving the fingers laterally, possessed by these muscles, must be exceedingly slight.

The *abductor pollicis*, Q, Q, (Fig. 2, P), arises from the trapezium or scaphoid, and the annular ligament, and receives a slip of origin from the tendon of the extensor ossis metacarpi pollicis, and often from the palmaris longus. It is a small flat

muscle, and is inserted on the outer side of the base of the first phalanx of the thumb, along with the outer head of the flexor brevis pollicis. From its insertion is prolonged a tendinous slip, Fig. 2, to join the tendon of the extensor secundi internodii pollicis. The muscle is subcutaneous and rests on the opponens, and on a part of the flexor brevis pollicis. It acts by drawing the thumb forwards.

The *opponens pollicis*, R, arises from the trapezium and the annular ligament, and is inserted into the whole length of the metacarpal bone of the thumb. It lies beneath the abductor pollicis, but a small piece projects beyond the outer side of the latter muscle. It rests on the flexor brevis pollicis and the metacarpal bone. Its action is to flex the thumb, by bringing the metacarpal bone towards the middle line of the hand; and thus, by causing the thumb to face the fingers, bears an important part in the movement known as opposition of the thumb.

The *flexor brevis pollicis*, S, S, consists of two heads, superficial and deep. The former arises from the trapezium and the annular ligament; the latter from the trapezoid, the os magnum, and from the bases of the second and third metacarpal bones. The muscle splits near the head of the metacarpal bone, and the digital arteries of the thumb usually pass through the interval thus formed; it is finally inserted into the two sesamoid bones in connection with the metacarpophalangeal articulation, and into the sides of the base of the first phalanx, the superficial head blending with the abductor pollicis, the deep head with the adductor. The superficial head is partly subcutaneous, and partly lies beneath the abductor; between it and the deep head, is the tendon of the flexor longus pollicis, and beneath the deep head lie the first dorsal interosseous muscle, the end of the radial artery, and the commencement of the deep palmar arch, with the branches of the radial to the thumb and index finger. Its action is to flex the thumb by drawing

the first phalanx and the metacarpal bone towards the middle line of the hand.

The *adductor pollicis*, T, arises from the ridge on the anterior surface of the third metacarpal bone, and is inserted with the deep head of the flexor brevis into the metacarpal phalanx of the thumb and the inner sesamoid bone. It is crossed by the outer tendons of the deep flexor, and rests upon the interossei and the second metacarpal bone. The muscle acts in opposition to the abductor, by drawing the metacarpal bone of the thumb backwards and towards the middle line of the hand.

The *abductor minimi digiti*, U, arises from the pisiform bone, and is inserted into the inner side of the base of the metacarpal phalanx of the little finger. It is subcutaneous, and rests upon the opponens minimi digiti. It acts as an abductor and a weak flexor of the little finger.

The *opponens minimi digiti*, V, arises from the hook of the unciform bone, and from the lower border of the annular ligament; it is inserted into the whole length of the fifth metacarpal bone. It rests on the metacarpal bone, and is covered by the abductor and the flexor minimi digiti. Its action is to draw the metacarpal bone of the little finger towards the middle line of the hand.

The *flexor brevis minimi digiti*, was in this subject, as is often the case, absent. It arises from the hook of the unciform bone, and from a small tendinous arch which stretches across the deep branches of the ulnar artery and nerve, to the pisiform bone. It is a small muscle, lying close to the abductor, and over the opponens, and is inserted with the former into the base of the first phalanx of the little finger. Its action is to bend the metacarpo-phalangeal joint of this finger.

ARTERIES.

The *ulnar*, b (Fig. 2, l, l), may be now studied in the whole of its course by comparing Fig. 2 with Fig. 3. The artery begins

at the bifurcation of the brachial, opposite the neck of the radius, and is directed at first downwards and inwards, and then vertically downwards, to the radial side of the pisiform bone. Its direction will be indicated on the surface of the limb, by drawing a line from the tip of the internal condyle to the outer side of the pisiform bone; the lower half of this corresponds to the lower half of the artery; the upper half of the vessel runs obliquely to the middle of the line, from a point an inch below the centre of the bend of the elbow. The ulnar artery is covered by the superficial layer of muscles, the pronator teres and the flexor sublimis being in immediate contact with it in the earlier part of its course, and the tendon of the flexor carpi ulnaris in the lower part; near the wrist, however, it is partly subcutaneous for a short distance; the ulnar origin of the flexor longus pollicis, and the median nerve, also cross the vessel. It rests upon the brachialis anticus and the flexor profundus digitorum. The ulnar nerve joins the artery in the middle of the forearm, and thence continues in contact with its inner side. *Venæ comites* surround the artery, which communicate by a large branch (*profunda*) with the median vein. Opposite the wrist, the ulnar is superficial to the anterior annular ligament, but is covered by a strong piece of fascia, and here it terminates as the superficial palmar arch.

To *ligature the ulnar artery at the wrist*, an incision two inches in length is made along the edge of the tendon of the flexor carpi ulnaris, or in a line drawn from the tip of the inner condyle to the radial side of the pisiform bone. After exposing the edge of the muscle and drawing it aside, a strong fascia is met with, and on dividing this, the artery and nerve appear in contact with one another. The needle is passed from the inner side. To *apply the ligature in the upper half of the forearm*, an incision three inches in length is made in the same line, a little above the middle of the

forearm. After cutting through the subcutaneous fat, a white line is seen, indicating the interval between the flexor carpi ulnaris and the flexor sublimis digitorum. The knife is drawn along this line, and then, with the handle of the scalpel, the two muscles are easily separated, and the artery is reached close to the point at which the nerve joins it. If the incision be not made well to the inner side of the limb, the surgeon is liable to mistake the interval between the flexor sublimis digitorum and the palmaris longus, for that for which he is in search. This would lead to great difficulty. It must be remembered that the part of the flexor sublimis here exposed is very narrow.

The ulnar gives off the following branches:—The *interosseous*, which will be described with the following Plate; the *anterior ulnar recurrent*, *d*, usually arises near the commencement of the artery and ascends beneath the pronator radii teres to anastomose with the anterior branch of the anastomotic, *k*; in this case this branch arose in common with the following; the *posterior ulnar recurrent*, *c*, leaves the ulnar a little lower down, and running upwards beneath the common origin of the superficial muscles, reaches the interval between the inner condyle and the olecranon, where it anastomoses with the inferior profunda and with the posterior branch of the anastomotic; *muscular and cutaneous offsets* leave the ulnar at different parts of its course. Near the lower end it gives off the *anterior carpal*, Plate 47, Fig. 1, *l*, which passing outwards over the wrist-joint, anastomoses with the anterior carpal of the radial and with twigs from the anterior interosseus. The *metacarpal* and *dorsal carpal*, *e*, come off either separately or together near the lower end of the ulna; the former passes to the back and inner side of the little finger, Plate 48, Fig. 2, *l*; the latter, Plate 48, Fig. 2, passes across the wrist to join the posterior carpal of the radial. As the ulnar artery lies on the annular ligament, it gives off the *deep branch to the palm* which passes backwards beneath the

tendinous arch from which the flexor brevis minimi digiti arises, or, if this muscle be absent, between the abductor and opponens minimi digiti; it inosculates the deep palmar arch after supplying twigs to the small muscles of the little finger.

The *superficial palmar arch*, Fig. 2, *m*, is the continuation of the ulnar artery across the palm, to which are joined, upon the outer side, two branches of the radial, the *superficial volar* Fig. 2, *e*, and the *radialis indicis*, Fig. 2, *k*. The shape of the arch, and the method of communication with the radial, are subject to considerable variation. In the condition which is considered typical, an arch with a slight convexity downwards, and formed principally from the ulnar, occupies a position roughly indicated in the palm by a line drawn inwards from the angle formed by the inner border of the extended thumb, with the outer border of the extended index finger. This line, after passing inwards to the middle of the palm, is gradually curved round to the radial side of the pisiform bone. The arch rests on the flexor tendons, and is covered by the palmar fascia and the palmaris brevis. The superficial palmar arch gives muscular and cutaneous branches to the palm, and digital branches to the inner side of the little finger, and the contiguous sides of the other fingers; the thumb and the outer side of the index being supplied by the radial. The inner digital artery is undivided; the others bifurcate opposite the web of the fingers, and send branches down the sides of the fingers, from which numerous small twigs are given off. There is a free anastomosis between the palmar and dorsal digital arteries on both sides of the fingers. The palmar ones supply the structures on the front of the fingers, the matrix of the nail, and the greater part of the back of the finger. The digital arteries communicate near the web of the fingers, with the interosseus branches of the deep arch; they also send backwards at a somewhat lower level small vessels to communicate with the interosseous branches on the dorsum of the hand.

The palmar arch and its digital branches must be carefully avoided whilst making incisions into the palm. If the arch be divided, it will be necessary to secure both ends, on account of the freedom of anastomosis. This procedure, which is often by no means easy, is described with great accuracy in surgical textbooks; here it will only be pointed out that by means of an accurate appreciation of the position of the vessels, a needle may sometimes with advantage be passed beneath one of them, and the patient may thus be saved the inconvenience of an extensive incision in the palm.

NERVES.

The *median*, 1, has been previously traced as far as the elbow (p. 402). In the forearm, it passes down the middle of the limb, at first occupying a position between the two heads of the pronator radii teres, and then lying between the superficial and deep flexors of the fingers. Near the wrist, it becomes superficial (Fig. 1), between the tendons of the flexor carpi radialis and palmaris longus, or sometimes beneath the latter. It then passes beneath the annular ligament where it becomes flattened out, and at the inner border divides into *digital branches*, one of which supplies the *outer side of the thumb*, one the *inner side of the thumb*, one the *index finger and the outer lumbrical muscle*, another the *contiguous sides of the index and middle fingers and the second lumbrical muscle*, and the last the *contiguous sides of the middle and ring fingers and a twig* (Fig. 2), 18, *to join the ulnar*. These digital nerves give off numerous branches to the front and back of the fingers; a brush of nervous twigs supplies the tip; a large branch on each side reaches the matrix of the nail, and those offsets which go to the back of the fingers join the digital branches on this aspect, and supply (except in the case of the thumb) the greater part of the two last joints. The digital nerves are superficial to their accompanying arteries in the

fingers. In addition to the digital branches, the median supplies, in the forearm, *muscular branches 2, 3, 4, to the pronator radii teres, the flexor carpi radialis, the palmaris longus, and the flexor sublimis digitorum*, and also gives off *the anterior interosseous nerve*, Plate 47, Fig. 1, 4. In the hand, a small muscular branch, 6, is distributed *to the abductor pollicis, the opponens pollicis, and half the flexor brevis pollicis*. Near the wrist, the median supplies a small *cutaneous branch to the palm*, 5.

The *ulnar*, 13, enters the forearm between the two origins of the flexor carpi ulnaris, and runs down the limb beneath this muscle resting on the surface of the flexor profundus digitorum. It meets the ulnar artery halfway down the forearm, and accompanies this vessel to its termination. It ends by dividing into two digital branches, one of which goes to the *inner side of the little finger*, and the other to the *contiguous sides of the little and ring fingers*, joining or being joined by a twig from the median. The branches of the digital nerves derived from the ulnar correspond exactly with those of the digital nerves which spring from the median. In the forearm, the ulnar nerve supplies branches to *the flexor carpi ulnaris*, 14, and to the *flexor profundus digitorum*, 15; a *dorsal branch*, 16, to the back of the hand (*see* Plate 48), and a *cutaneous branch to the palm*, Fig. 2, 15; the last is a very small twig, which leaves the nerve half way down the forearm, and runs on the anterior surface of the ulnar artery; it gives off numerous fine branches, one of which joins the internal cutaneous, and ends at the inner part of the palm. In the hand, the ulnar gives off a twig *to the palmaris brevis*, Fig. 2, 17, and a *deep branch* (Plate 47, Fig. 1), which accompanies the deep branch of the artery beneath the short muscles of the little finger, and supplies these muscles as well as the inner two lumbricales, the adductor, and half the flexor brevis pollicis and all the interossei.

PLATE 47.

FIG. 1.

THE dissection here shown is a continuation of the series which formed the subject of Plate 46. It was made from that drawn in Fig. 3 of that Plate, by cutting the median nerve below the level at which it gives off the anterior interosseous, and removing the lower part. The tendons of the flexor longus pollicis and flexor profundus digitorum were then in part removed, the insertions being thrown down, while the muscles themselves were separated from one another, in order to expose the pronator quadratus and the anterior interosseous vessels and nerve; at the same time, the outer slip of the flexor profundus was separated from the rest of the muscle. The muscular origins were completely taken away from the internal condyle and the internal lateral ligament of the elbow, and the extensor carpi radialis longior was in great part removed. In the palm, all the short muscles of the thumb were taken away, as well as the two digital nerves to the thumb, which are shown in the last drawing. Lastly, the deep palmar arch and the deep branch of the ulnar nerve were cleaned, and the sheath of the flexor carpi radialis was opened.

MUSCLES.

The *pronator quadratus*, N, is a flat and somewhat square muscle, arising from the lower end of the anterior surface of the ulna for about a quarter of the length of the bone, and inserted for a somewhat shorter distance into the anterior surface of the radius at the lower end. It is covered by the flexor longus pollicis and the flexor profundus digitorum, except at the extreme outer part, where the radial artery crosses it, some fat and cellular tissue intervening. It rests upon the lower ends of the

radius and ulna, upon the interosseous membrane, and the anterior interosseous vessels and nerve. Its only action is that of pronation.

The *interossei* are small muscles occupying the spaces between the metacarpal bones. They are arranged in two sets, palmar and dorsal. The *palmar* are three in number, and arise each from one metacarpal bone—viz., from the ulnar side of that of the index, W, and from the radial sides of those of the ring, W, and little finger, X; the *dorsal*, rather deeper in position, are four in number, and arise in each case from both the metacarpal bones bounding the spaces in which they lie. The first, *abductor indicis*, R, is large, and is inserted on the radial side of the index finger; the other three are smaller, and are inserted respectively on the radial side of the middle finger, S, the ulnar side of the middle finger, T, and the ulnar side of the ring finger, U. The insertion, in the case of both the palmar and dorsal muscles, is by means of flat tendons, which are generally attached to the sides of the base of the first phalanx, and join the expansion of the extensor communis digitorum; the tendons of the interossei, together with that of the lumbricalis to each finger, form the principal part of the continuation of this expansion, which, passing over the back of the second phalanx, is attached to the third. The abductor indicis is almost covered by the flexor brevis and the adductor pollicis; the radial artery enters the palm between the two heads of origin of the muscle and rests for a short distance upon its anterior surface, as do also two of its branches, the arteria princeps pollicis, and the radialis indicis. The palmar interossei act as adductors towards the middle line of the middle finger, the dorsal ones as abductors from the same line; but besides this action, they are all rather powerful flexors of the metacarpophalangeal joints, and by means of their insertion into the expansion of the extensor tendons, they are extensors, first of the terminal, and then of the second, phalanges of the fingers. It is thus apparent that they supplement the action both of the long flexors

and of the extensor of the fingers, the former acting principally upon the two terminal phalanges, the latter almost entirely upon the first. When the interossei are paralysed, this fact is illustrated by the peculiar deformity of the hand, known as the "main en griffe," in which the first phalanges are forcibly extended, while the second and third are drawn in towards the palm.*

ARTERIES.

Radial, b. This artery may be seen in this Plate, passing round the outer side of the wrist, Fig. 2, *a*, and it again appears in the deep part of the palm, Fig. 1, *c*. It has previously been traced to the lower part of the styloid process of the radius (p. 415). Below this process of bone, the artery is directed across the outer side of the wrist to the base of the first interosseous space, where it disappears between the two heads of the abductor indicis. In this position it is in part subcutaneous, and is covered by the three extensors of the thumb, by the radial vein, and by some branches of the radial nerve. The vessel rests on the external lateral ligament of the wrist, and on the os trapezium. In this part of its course, the radial gives off several branches to the back of the hand, which are better seen in the following Plate. They are:—the *posterior carpal*, Plate 48, Fig. 2, *c*, which runs across the back of the wrist, joining with a corresponding branch of the ulnar, and with terminal twigs of both the anterior and posterior interosseous arteries; two branches, *dorsales pollicis*, *b*, *c*, which run down the inner and outer sides of the dorsal surface of the thumb; a similar one to the outer side of the index finger, *dorsalis indicis*, *d*; and a branch to the first interosseous space, called the *first dorsal interosseous*, *e*. This last, like the other

* For a very interesting account of the action of the interossei and the short muscles of the thumb the reader is referred to Dr. Duchenne's "Physiologie des Mouvements."

dorsal interosseous arteries, is joined by a perforating branch from the deep palmar arch.

The radial is sometimes ligatured in this position. An incision is made from the junction of the styloid process with the radius, to the base of the first metacarpal bone. The subcutaneous fat is divided, and the radial vein and the radial nerve, if seen, are pulled aside, when, on cutting more deeply, the artery is found crossing the line of incision, and nearer to the metacarpal bone than to the radius.

After entering the palm between the two heads of the abductor indicis, the radial takes a transverse course inwards, lying at first on this muscle, and beneath the deep head of the flexor brevis pollicis; as it passes inwards, it emerges between the flexor brevis and the abductor pollicis, or through some fibres of the former muscle, and crossing the bases of the metacarpal bones it joins the deep branch of the ulnar artery. This part of the radial is known as the *deep palmar arch, c*; its position is indicated by a line drawn across the palm a quarter of an inch above that which marks the superficial arch. Its course, however, is more direct. From the concavity of the arch are given off small twigs which supply the carpal articulations and ligaments. From its convexity spring three interosseous branches, which run down the inner interosseous spaces, communicating near the web of the fingers with the digital branches of the superficial arch, and at the posterior part of the interosseous spaces, with the *dorsal interosseous arteries* by means of perforating branches. This part of the radial supplies, in addition to the deep palmar arch, a branch to the thumb, the *arteria princeps pollicis* which, after running along the metacarpal bone of the thumb beneath the flexor brevis pollicis, divides into two branches; these, passing beneath the two heads of the muscle, are distributed, like the digital branches of the fingers, to the two sides of the anterior surface of the thumb. The *arteria radialis indicis*,

Plate 46, Fig. 2, *k*, is the digital artery of the radial side of the index finger, and usually has a communication with the superficial palmar arch. It came off, in this subject, from the inner of the two digital arteries of the thumb.

The *interosseous artery* is a branch of the ulnar, arising near the commencement of this vessel. It is about an inch in length, and is completely hidden in this drawing by the median nerve. It divides, at the upper part of the interosseous membrane, into the anterior and posterior interosseous arteries; the latter is shown in the following Plate, the former is in part seen in this. The *anterior interosseous*, *n*, runs down the front of the interosseous membrane between the flexor profundus digitorum and the flexor longus pollicis, and then lies beneath the pronator quadratus. Near the upper border of this muscle, it passes through an aperture in the interosseous membrane to reach the back of the limb, Plate 48, Fig. 2, *b*, where it supplies a branch of some size to the structures on the radial side, and ends by joining the anastomosis between the posterior carpal branches of the radial and ulnar at the back of the wrist. In the front of the forearm, the anterior interosseous supplies *numerous branches to the deep muscles*, a *nutrient artery to the radius*, and *one to the ulna*, both of which have an ascending course, and the *comes nervi mediani*, a very small twig which accompanies the median nerve. This median artery is often of considerable size, and, in this case, it may pass into the palm beneath the annular ligament, and join the superficial palmar arch, or supply some of the digital branches. Before piercing the interosseous membrane, the anterior interosseous sends downwards a branch to join in the anastomosis of the anterior carpal branches of the radial and ulnar on the front of the wrist.

NERVES.

The *anterior interosseous*, 4, is a branch of the median. It accompanies the artery of the same name as far as the under surface of the pronator quadratus, in which muscle it ends. The nerve supplies, in addition to the pronator quadratus, the flexor longus pollicis and the outer half of the flexor profundus digitorum.

The *deep branch of the ulnar* passes into the deep part of the palm with its companion artery, beneath the flexor brevis minimi digiti, if this muscle be present, or if, as in this case, it be absent between the abductor and opponens minimi digiti. It accompanies the deep palmar arch for a short distance, and then breaks up into numerous branches which supply the inner two lumbricales, all the interossei, and the adductor and the deep part of the flexor brevis pollicis. Near its commencement it gives off twigs to the muscles of the little finger.

FIG. 2.

This dissection was made by carrying two vertical incisions, one from the knuckle of the middle finger over the middle of the back of the hand and forearm, to the olecranon, whence it was prolonged upwards for about the lower third of the arm; the other, from the front of the metacarpal bone of the thumb, to a point a little outside the middle of the front of the wrist, whence it was continued upwards over the front of the biceps tendon, to the junction of the middle and lower thirds of the arm. These two incisions were joined above and below by transverse cuts; the position of the subcutaneous vessels and nerves was ascertained, and the parts beneath the deep fascia were cleaned. All the structures here shown are

described in connection with other plates. The drawing is intended to illustrate the mutual relations of the parts upon the front and back of the forearm, and of some of those above and below the elbow. Attention is particularly directed to the shape of the supinator longus, and to the fact that its belly touches the extensor carpi radialis brevis. The dissection also serves to show the arrangement of the tendons at the outer part of the wrist, and the course of the radial artery in this situation.

PLATE 48.

FIG. 1.

THE dissection for this Drawing, which exhibits the structures at the back of the forearm and hand, was made by carrying two vertical incisions along the forearm; one extending from the tip of the olecranon over the inner side of the wrist to the tip of the little finger; and the other, from the prominence of the supinator longus to the outer border of the thumb. These were joined by a transverse cut above; while below, incisions were made on each side of all the fingers except the index. The enclosed piece of skin was taken away, and the position of the subcutaneous vessels and nerves was recorded. The deep fascia was then removed, with the exception of the posterior annular ligament, and the subjacent structures were cleaned.

The *posterior annular ligament*, ¶, differs in many ways from the corresponding structure on the opposite side of the limb. It is a thickened part of the deep fascia of the back of the forearm, the fibres of which are directed downwards and inwards, from the anterior edge of the lower end of the radius to the cuneiform and pisiform bones. The space beneath it is subdivided by fibrous septa into six spaces, lined by separate synovial membranes, through which the extensor tendons pass. An attempt has been made in Fig. 2, to represent the upper and lower limits of these synovial membranes, as they surround the tendons of the extensor carpi ulnaris, and the extensor minimi digiti. In each case, they extend for somewhat less than an inch both above and below the annular ligament. The various compartments have been opened in Fig. 2; in the outermost one are contained the tendons of the extensor ossis metacarpi and the extensor primi internodii pollicis; in the

second, the two radial extensors of the wrist; in the third, the extensor secundi internodii pollicis; in the fourth, the extensor communis digitorum, and the extensor indicis, this piece of the membrane enclosing as well the posterior interosseous nerve and a branch of the anterior interosseous artery; the next compartment contains the extensor minimi digiti, and the innermost, the extensor carpi ulnaris. The sheaths may become the seat of ganglion; in which case the surgeon must remember that the tumour will, in all probability, be subdivided by numerous septa, and that accordingly one puncture may not effect more than a very partial evacuation of its contents. A similar affection of the sheath of the flexor tendons causes a swelling both above and below the annular ligament, between which a sense of fluctuation may be obtained. A ganglion on the front of the wrist consists, as a rule, of a single cavity.

MUSCLES.

The *anconeus*, Fig. 2, E, is a small triangular muscle, continuous above with the lowest and outermost fibres of the inner head of the triceps—viz., those which arise from the back of the humerus close to the outer condyle. The anconeus arises by a tendon from the back of the external condyle, near, but slightly internal, to the common origin of the extensor muscles. Its fibres are directed downwards and inwards, and it is inserted on the outer side of the olecranon and upon the contiguous part of the upper third of the posterior surface of the ulna. The muscle is covered by a strong piece of fascia, +, Fig. 2, †, which is derived from the tendon of the triceps (p. 392). The surgeon should endeavour to preserve this fascia in excising the elbow, as it adds stability to the joint after this operation. The anconeus is subcutaneous; and rests on the elbow joint and the supinator brevis; its outer border touches the extensor carpi ulnaris. It acts as an extensor of the elbow.

The *extensor carpi ulnaris*, F, arises from the outer condyle, near the tip, by an origin common to it, and the extensor minimi digiti, the extensor communis digitorum, and the extensor carpi radialis brevis. It also arises from the fascia of the forearm, and from the intermuscular septum on its outer side; and it is strongly bound down by fascia to the posterior border of the ulna. Its tendon passes through the inner compartment of the annular ligament, occupying the groove on the lower end of the ulna, and is inserted into the tubercle at the base of the metacarpal bone of the little finger. The muscle rests upon the back of the ulna and upon the supinator brevis, the extensor ossis metacarpi, and the extensor secundi internodii pollicis, the extensor indicis, and the wrist-joint. The extensor carpi ulnaris extends the wrist, and draws the hand to the inner side; it is also an extensor of the elbow.

The *extensor minimi digiti*, E, arises with the extensor communis digitorum from the outer condyle, and also from the fascia of the forearm and the intermuscular septa. Its tendon passes through a separate compartment in the annular ligament, and occupies a groove corresponding to the interval between the radius and the ulna. Below the annular ligament it splits into two parts, which unite again near the metacarpo-phalangeal articulation, after the outer has been joined by a small slip derived from the extensor communis digitorum. The muscle is subcutaneous; it rests on the supinator brevis, the extensor ossis metacarpi and the extensor secundi internodii pollicis, the extensor indicis, the wrist-joint, and the inner interosseous space. Its action will be described with that of the following muscle (see page 437).

The *extensor communis digitorum*, D, arises by the common tendon from the external condyle, from the intermuscular septa on each side of it, and from the fascia of the forearm. It ends in a broad tendon which passes beneath the annular

ligament, and there splits into three main pieces. These tendons are flat and often subdivided; the outermost joins with the tendon of the extensor indicis, and the innermost sends a slender piece to join the extensor minimi digiti. Strong cross bands unite the tendon of the ring finger with those on either side of it. Each tendon is very firmly bound down to the metacarpo-phalangeal joint and the base of the first phalanx, and then spreads out into a broad expansion, which receives at each side strong bundles of fibres from the interossei and lumbricales. Near the distal end of the first phalanx, this expansion splits into three parts; the central of which is principally derived from the extensor tendon itself, and is attached to the back of the base of the second phalanx; while the lateral parts are almost entirely derived from the interossei and lumbricales, and unite over the second phalanx in another expansion, which is inserted into the back of the base of the terminal phalanx. The action of the muscle (for an account of which the reader is again referred to Dr. Duchenne's excellent description, "Physiologie des Mouvements") is principally to extend the proximal phalanges, but secondarily, and more feebly, to extend the second and third joints. It also extends the wrist and the elbow. The movements of the ring finger are restricted by the cross bands mentioned above; those of the little and index fingers are rendered much more independent by the special muscles with which they are supplied. The extensor communis is subcutaneous; it rests upon the deep set of muscles, upon the wrist-joint, the metacarpal bones, and the interosseous spaces.

The *extensor carpi radialis brevis*, C, arises by the common tendon from the external condyle, from the external lateral ligament of the elbow, from the fascia of the forearm, and from the intermuscular septum between it and the extensor communis digitorum. The tendon, which appears upon the outer surface of the muscle, passes beneath the

tendons of the extensors of the metacarpal bone and the first phalanx of the thumb, then beneath the annular ligament in the same sheath as the extensor carpi radialis longior, and lastly beneath the tendon of the extensor secundi internodii pollicis, to be inserted into the base of the metacarpal bone of the middle finger. The muscle is subcutaneous, except where it is crossed by the structures mentioned above, and where it is overlapped by the extensor carpi radialis longior. It rests upon the supinator brevis, the radius, and the wrist-joint. Its outer edge corresponds almost exactly, for a considerable distance, with that of the extensor carpi radialis longior, and along this border is placed the radial nerve. The muscle acts as an extensor and abductor of the wrist, and like the extensor carpi radialis longior, as a weak flexor of the elbow.

The *extensor carpi radialis longior*, B, has been partially seen in the dissections of the back of the arm and the front of the forearm. It arises from the lower third of the external supra-condylar ridge of the humerus, and from the external intermuscular septum of the arm. It takes a similar direction to that of the last muscle, and is inserted into the base of the metacarpal bone of the index finger. This muscle is in part subcutaneous, but it is overlapped considerably by the supinator longus, and is crossed by the extensor ossis metacarpi and the extensor primi internodii pollicis, and, at its insertion, by the extensor secundi internodii pollicis. Beneath the annular ligament, it occupies the same compartment as the short radial extensor. It rests upon the brachialis anticus, the short radial extensor, the radius, and the wrist-joint. It acts as an extensor and abductor of the wrist, and a weak flexor of the elbow.

The *supinator longus*, A, has been described at p. 408.

ARTERIES.

The cutaneous arteries at the back of the forearm are derived from the radial recurrent, the posterior interosseous and from the anterior interosseous. At the back of the wrist is a superficial anastomosis between branches of the radial and ulnar, as well as a deep inosculation of the posterior carpal branches of these two vessels, Fig. 2, *c, d*. The inner side of the little finger is supplied by the metacarpal branch of the ulnar, Fig. 2, *l*; the contiguous sides of the fingers are supplied in part by the dorsal interosseous arteries derived from the posterior carpal arch, the outermost of which is usually described as a branch of the radial. The branches to the outer side of the index finger, and to both sides of the thumb, come direct from the radial (p. 429). In the fingers, these dorsal digital vessels do not extend much below the metacarpo-phalangeal articulations; the rest of the dorsal surface receiving twigs which are sent back from the palmar digital arteries.

VEINS.

The superficial veins at the back of the forearm are not numerous, and most of such as exist have been removed in the dissection figured. An arch across the back of the hand gives rise at the outer part to the *radial vein*, *a*, and at the inner part to the *posterior ulnar*, *β*. The radial is interesting to the surgeon, from its relation to the radial artery at one of the points selected for the ligature (see p. 430).

NERVES.

The back of the forearm receives cutaneous branches from the *internal cutaneous*, 4, the *external cutaneous of the musculo-spiral*, 1, and the *musculo-cutaneous*, 2. The dorsum of the hand is supplied by the *dorsal branch of the ulnar*, 5, and by

the *radial*, 3; these two nerves are joined by a transverse branch, and they send digital branches to the fingers. The number of fingers supplied by each is not constant, sometimes the ulnar reaches only the little and half the ring finger, but perhaps more frequently, it supplies, in addition, the cleft between the ring and middle fingers. These digital nerves do not, as a rule, extend further than the end of the first phalanx in the fingers; they join twigs from the palmar digital branches. In the thumb, the nerves reach the tip and help in the supply of the matrix of the nail. In this dissection, those which went to the little finger extended to the unguinal phalanx.

Notwithstanding that the ulnar usually gives more digital branches to the back of the hand than to the palm, the comparative shortness of the dorsal branches fully accounts for the fact, that injury to the trunk of the nerve paralyzes sensation in the little finger and the ulnar half of the ring finger only, both in front and behind; the radial side of the dorsum of the ring finger being principally supplied by the median.

FIG. 2.

This dissection was made from the last, by removing the cutaneous vessels and nerves; opening the several compartments of the annular ligament; and dividing, and in great part removing, the muscles of the superficial layer, with the exception of the anconeus, which was slightly raised, and the supinator longus which was forcibly turned aside. The skin was taken from the index finger, and the parts uncovered were carefully cleaned.

MUSCLES.

The *supinator brevis*, H, arises from a triangular surface on the outer aspect of the ulna, below the lesser sigmoid cavity,

from the orbicular ligament of the radius, and from the external lateral ligament of the elbow. Its fibres pass downwards and outwards to the radius; but the longest, which reach the anterior surface of the bone, are directed downwards and inwards in the floor of the triangular space in front of the elbow. Its insertion surrounds the bone, except on the inner aspect of the neck, and is limited in front by the oblique line, and behind by the upper border of the extensor ossis metacarpi pollicis. The deep surface of the muscle is in contact with a very small piece of the interosseous membrane and the radius; while the opposite surface is covered by the superficial muscles at the back of the forearm, and in front is slightly overlapped by the pronator radii teres, the radial artery and nerve resting upon it. The posterior interosseous artery reaches the back of the forearm beneath the lower border of the muscle; and the posterior interosseous nerve passes round the radius amongst its fibres. The action of the supinator brevis that of a supinator of the forearm.

The *extensor ossis metacarpi pollicis*, J, arises from the upper impression on the outer part of the posterior surface of the ulna; from the posterior surface of the radius, below the insertion of the supinator brevis; and from the intervening part of the interosseous membrane. It is inserted into the base of the metacarpal bone of the thumb, its tendon being subdivided, and sending one slip to the trapezium and to the origin of the abductor pollicis. This extensor lies at first beneath the superficial layer of muscles, resting upon the bones and the interosseous membrane; but, near the radial border of the limb it emerges from beneath the extensor communis digitorum, and becoming superficial, it passes beneath the annular ligament in the same sheath as the extensor primi internodii pollicis. After it has become superficial, the muscle crosses the two radial extensors of the wrist, the supinator longus, the radius, and the radial artery. The action of the extensor

ossis metacarpi pollicis is to extend the metacarpal bone of the thumb, and to help in abducting the hand.

The *extensor primi internodii pollicis*, K, arises from the back of the radius and from the interosseous membrane, below the muscle last described, with which it is often inseparably united. The relations of the two muscles are almost identical, but the tendon of the *extensor primi internodii*, which is very small, passes onwards along the back of the metacarpal bone, and is inserted into the base of the first phalanx of the thumb, often sending a slip to join the tendon of the *extensor* of the second phalanx. The muscle extends the first joint of the thumb, and aids in abducting the hand.

The *extensor secundi internodii pollicis*, L, arises from the second of the three impressions on the outer part of the posterior surface of the ulna, and also for a corresponding distance from the interosseous membrane. It is at first in close contact with the other two extensors of the thumb, but leaves them near the wrist, its tendon passing through a distinct compartment in the annular ligament, and occupying the oblique groove at the back of the radius. After crossing the radial artery, it expands at the back of the first phalanx of the thumb, into a broader tendon, which is joined by a slip from that of the *extensor primi internodii pollicis*, and by others on each side from one of the short muscles of the thumb, usually the *flexor brevis pollicis*. It is inserted into the base of the terminal phalanx. The tendon of the muscle is subcutaneous; the belly is almost completely covered by the muscles of the superficial layer. It rests on the ulna, the interosseous membrane, the radius, and the wrist, the posterior interosseous nerve and the anterior interosseous artery. The muscle acts as an extensor of the terminal phalanx of the thumb, and also in drawing the whole thumb backwards and extending the wrist.

The *extensor indicis*, M, arises from the lowest of the three marks on the outer part of the posterior surface of the

ulna, and from a corresponding piece of the interosseous membrane. Its tendon passes beneath the annular ligament in the same compartment as the extensor communis digitorum, and ends by blending with the outermost tendon of this muscle, near the head of the metacarpal bone of the index finger. The extensor indicis is covered by the extensor communis digitorum and the extensor minimi digiti, except where the tendon is subcutaneous at the back of the hand; it rests on the ulna and the interosseous membrane, the wrist, the middle metacarpal bone and the second interosseous space. It extends the index finger and the wrist-joint.

ARTERIES.

The *posterior interosseous*, *a*, a terminal branch of the interosseous trunk, enters the back of the forearm above the interosseous membrane. After passing beneath the lower border of the supinator brevis, it lies close to the posterior interosseous nerve, which it accompanies as far as the upper border of the extensor secundi internodii pollicis. The artery becomes superficial in the lower third of the forearm, and runs downwards between the tendons of the extensor carpi ulnaris and the extensor minimi digiti, ending by fine twigs which join with the posterior carpal arch. It supplies numerous *muscular branches* to the muscles among which it runs, and *cutaneous twigs* to the back and ulnar side of the forearm. It also gives off the following named branch:—the *posterior interosseous recurrent*, *o*; this large trunk runs up beneath the edge of the anconeus, and anastomoses at the back of the elbow with the posterior branch of the superior profunda.

Several other arteries are now seen which have been before described—viz., the radial recurrent (p. 416), the end of the anterior interosseous (p. 431), the posterior carpal arch (p. 429), and a part of the radial itself (p. 429).

NERVES.

The *posterior interosseous nerve*, 2, is one of the terminal divisions of the musculo-spiral. Beginning in front of the outer condyle of the humerus, the nerve enters the fibres of the supinator brevis, winds round the outer side of the radius, and piercing the posterior part of the supinator, comes into contact with the artery of the same name. After accompanying the vessel for a short distance, the nerve dips beneath the extensor secundi internodii pollicis, and pursuing its course downwards on the interosseous membrane in company with the termination of the anterior interosseous artery, it passes beneath the annular ligament in the same compartment as the extensor communis digitorum and the extensor indicis. At this point it has, in most instances, a considerable gangli-form enlargement, from which spring its terminal branches. Some of these pass at once to the carpal articulations; other very fine twigs run down in the interosseous spaces to supply the metacarpo-phalangeal joints. The posterior interosseous nerve usually supplies all the muscles at the back of the forearm, except the extensor carpi radialis longior, the anconeus, and the supinator longus. The nerve to the extensor carpi radialis brevior, may, however, be derived from the musculo-spiral, before its division, or from the radial.

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